MODEL AIRPLANE NEWS

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January 1996

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JANUARY 1996 VOLUME 124, NUMBER 1

MODEL AIRPLANE NEWS

FEATURES

ABOVE: *Steve Elias, seen here with his F-80 built from a Bob Violett Models kit, had the highest flight score and placed third overall at this year's World Jet Masters. Incredibly, Steve was still applying chrome finish and markings to this model the night before the contest, and he only managed one short test-hop before the flying rounds started! See page 36 for more coverage of this "jet-set" contest. (Photo by Mike Cherry.)*

ON THE COVER: *Just as poignant as when it first graced Model Airplane News in June, 1930, this Jean Oldham drawing mirrors David Daniel's article, "Hobby Shop Memoirs"—a moving account of boyhood modeling found on page 20 of this issue.*

FEATURES

CONSTRUCTION

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COLUMNS

DEPARTMENTS

EDITORIAL

TOM ATWOOD

NEW INSIGHTS INTO FLIGHT

Do you remember the excitement you felt when, as a kid, you first saw a well-constructed paper airplane fly across the room? Whether you preferred gliders that floated serenely or faster ships that zipped through the air like arrows, you were probably forming your first ideas on how aircraft stay aloft.

For many modelers, that early curiosity about flight has driven a lifelong interest in diverse aircraft designs. The efficient, elliptical wings of the Supermarine Spitfire, the sleek, high-speed design of the Lockheed SR-71 Blackbird, the unexpected performance of lifting body designs like that of the space shuttle, even the first designs of the Wright brothers—all tend to pique the imaginations of modelers, owing, in large part, to our desire to conceptualize the mechanics of flight.

Modelers also show a penchant to argue aircraft-design pros and cons and, understandably, to be armchair aerodynamicists (those who are full-fledged aeronautical engineers add still more to the discussion!). Is it not extraordinary then, with all the thinking and talking about flight going on since the dawn of flight (not only by modelers, but also by teachers, engineers and physicists), that disputes would continue to emerge on how wings actually fly?

We further this dialogue, this issue, with an interesting new contribution to the subject by contributor Jef Raskin. Jef explains, in simplest terms, how knowing a little about a phenomenon called the "Coanda Effect" helps you visualize how planes fly. Jef shows how the traditional explanation, often oversimplified in popular publications and textbooks, falls short of the mark. See "Understanding How Models Fly, Really."

On this subject, a more detailed article by the same author is, "Physics of Flight: Foiled by the Coanda Effect," published in the September/October '94 issue of *Quantum* (page 5). The *Quantum* article has garnered a lot of media attention. It was written up in the London *Sunday Telegraph*, Jef was interviewed by the BBC on the topic, and it was the featured subject on National Public Radio's "TechNation" program, hosted by Dr. Moira Gunn.

Jef has received many letters of praise and encouragement from aerodynamicists around the world and letters of thanks from previously puzzled students and teachers of physics. If you pride yourself on your command of this subject (and we think most modelers do), don't miss Jef's article!

David Daniels, author of "Hobby Shop Memoirs," gazes at us from an earlier era while holding his Loening Amphibian.

NOSTALGIA ROAD

Many of us look back on the earlier years of the hobby with pride, satisfaction and some wistfulness. That was a simpler time when aviation loomed a little larger in the popular imagination and hobby shops, as some of us recall, may have figured a little more prominently in the minds of youngsters. In this issue, we salute that period with David Daniel's "Hobby Shop Memoirs" (David, who at 14 was perhaps the youngest WW II aircraft mechanic, still flies his '52 deBolt Live Wire), and with our continued tradition of annually publishing a vintage cover. This issue's cover, by Jean Oldham, was first published on the front of *Model Airplane News* in June, 1930.

REVISED PLANS DIRECTORY

In this issue, you'll find a revised directory of our best-selling plans. If you are a scratch-builder, or are thinking of becoming one, take a look at the selection. One of the nice things about building from scratch is that you can customize to your heart's content. Check out the directory and consider the possibilities.

MAYNARD HILL TAKES ANOTHER ONE

We reported in the November issue that, on June 10, Ron Clem, of San Diego, CA, had bested the 1994 straight-line distance record held by renowned R/C aircraft record-breaker Maynard Hill, who hails from Silver Spring, MD. We also noted that on June 26, Maynard had established a new closed-course distance record. You might have expected it: on August 29, '95, Maynard and his team again broke the straight-line distance record. The flight started at 8:09 a.m. at the Flying Circus Aerodrome field near Bealeton, VA, and it ended at 4:52 p.m. on a sod farm near Ridgeland, SC. The flight covered a straight-line distance of 457.8 miles (521 road miles were flown) to beat Ron Clem's previous record of 427.3 miles.

The model was flown from an antique Ford LTD convertible specially fitted with wind barriers, a telemetry receiver, a Global Position System Receiver and a ham-radio link to the chase van. This was the 22nd world record established by Maynard, a past president of the AMA and a former U.S. delegate to the FAI. Congrats to Maynard and his team. ■

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AIRWAVES

WRITE TO US! We welcome your comments and suggestions. Letters should be addressed to "Airwaves," **Model Airplane News,** 251 Danbury Road, Wilton, CT 06897. Letters may be edited for clarity and brevity. We regret that, owing to the tremendous numbers of letters we receive, we cannot respond to every one.

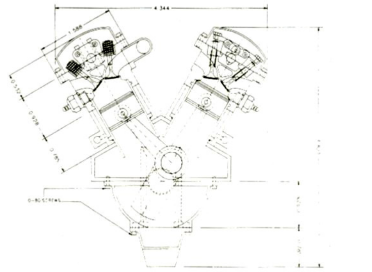
SERVO SETUP

I'm starting my first scratch-built project that I designed and drew the plans for. I've built my share of kits, but I can't decide on the best servo setup and control linkage for a 72-inch-wingspan biplane. My model is an EAA experimental aerobatic design called the Acro Sport. Hope you can help.

RICHARD VERRIER
Prince Edward Island, Canada

Rich, congratulations on becoming a designer. There's an old saying that, "Scale modelers are copycats." So,following that axiom, the best place to look for control layouts and linkage setups is probably in other designers' plans. I like the EAA Acro Sport biplane, and I have some documentation on the full-size aircraft. You didn't say what you have hung on your firewall, but I guess it's a Quadra or a Zenoah gas engine swinging your prop. If so, concentrate on making a rigid assembly. Gas engines have a lot of power and torque, so don't use anything less than doubled, 60-ounce-torque servos (use a separate servo for each control surface—two for ailerons, two for elevator). The full-size Acro Sport biplane uses pushrod control for elevator and aileron control, so in keeping with scale, you can use this in your model. Keep the pushrods as short as is practical, and support the rods adequately. Use only 4-40-size clevises and heavy-duty control horns, such as those available from Du-Bro, Rocket City and Robart Mfg. For scale fidelity, Cirrus Ventures offers excellent control systems that look and act exactly like full-size control systems; their 90-degree bellcranks and idler bellcranks are ideal for precise positioning of the control rods and control linkages. Many companies offer pull/pull systems for rudder control, and you should consider using such a setup for scale appearance and positive yaw control. Don't hook up the cables directly to the servo, as many modelers do, because it puts unwanted side loads on the servo's output shaft. A better solution is to build a straight bellcrank (tiller arm) into the system and connect the rudder cables to it. Then install a short pushrod between the tiller arm and the servo.

A good way to save weight (by eliminating long pushrods) is to place the servos farther aft (this also helps to balance the model, which can be nose-heavy if a large, gas engine is used). Place the servos for rudder and elevator in the tail, and run short pushrods to the control horns. Placing separate servos in each bottom wing panel just in front of each aileron is also a good way to provide simplified roll control. This works especially well if you drive the two top ailerons with slave struts from the bottom ailerons. And, by all means, use at least a 1000mAh battery pack. In the future, we'll publish articles that deal specifically with sound and proper servo and control setups for models. Stay tuned! GY



CAD UPDATE

I enjoyed reading the product review on DesignCAD Version 6.0 in the October '95 issue, but I'm surprised that the author wasn't even more enthusiastic about using it. I am working on drawings for a 1/7-scale working model of a V 12 Allison engine. I have a 386 33MHz with a math co-processor, 4MB RAM, SVGA monitor, 61MB hard drive, Windows 3.1 and DOS 6.0. I have tried Key-CAD Complete, Turbo CAD and ModelCAD only to find that

they fall short of my needs. I am using the DesignCAD Version 6.2 and have had zero problems. I have enclosed one of my drawings of the project. The printing is very clear. I can also reprint the drawing to different scales, so when I decide to build a bigger version of this engine, it will be fairly simple. The drawing is a sectional view through the front of the engine, and it took me a few days to complete it. I purchased the optional videos to help me see what the software would look like and do; these are very helpful. Plus, I read a book about DesignCAD by Emmett Carmody titled, "Drafting with DesignCAD," that can also be bought from American Small Business Computers. Overall, I have found the program easy to use, and the price is very competitive. This program is very powerful. After playing with it for a few hours, I was ready to do some serious drawing. The other programs would not have allowed me to do what I have already accomplished in so short a time. Although this computer is adequate, I find that, as the drawings become more detailed, the regeneration time becomes longer; this tells me I need to upgrade to a faster computer with more RAM. I give this program a thumbs up. Keep up the great magazine.

JAMES L. GRAY
Beaumont, TX

James, thanks for sharing your CAD experiences with us. The engine drawing looks great, and we're interested in hearing about the results, so keep us informed. Model Airplane News will continue to review CAD programs that make designing and building model airplanes easier. Such a review can be found in this month's "Scoop" column on computer-generated NACA airfoils. RP

SCALE COVERINGS

I heard that some modelers are covering their scale model aircraft with the same fabric that's used on full-size aircraft. Wouldn't grade-A cotton and the many coats of clear dope, silver undercoating and final color coat be too heavy for all but the largest of scale models? I'd love to hear about something that's light and authentic.

CHRIS SMITHENSON
Kingston, Ontario, Canada

Chris, as far as we know, grade-A cotton isn't being used with R/C scale aircraft. Many modelers use Poly Fiber Fabric. It comes in a variety of weights and has no adhesive. F&M Enterprises, 22522 Auburn Dale Dr., El Toro, CA 92630; (714) 583-1455, offers a specially formulated version—the Scale Stits Covering System; it's designed specifically for models and includes Poly Fiber, adhesive, cloth primer, a silver coat and Poly Tone paint. GY ■

Product Guide

ISOLATION ENGINE MOUNTS

by GERRY YARRISH

Stop the shake, rattle and roll

THERE ARE two good reasons to *not* hard-mount your engine: noise and vibration—both of which hard-mounting contributes to.

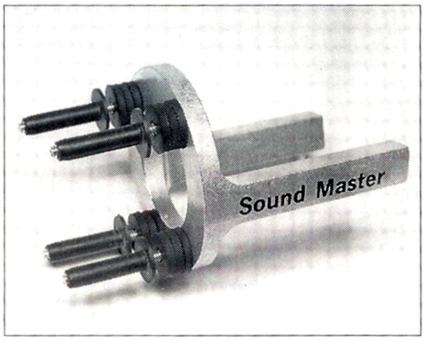
NOISE

A lot of work has gone into decreasing the noise that R/C model planes make. Many clubs have implemented stricter dB limits. Engine noise is only part of the problem, though, so adding a quieter muffler won't necessarily cut down the noise enough. You have to look at your model as a whole and understand that other things, such as the propeller, vibration, etc., contribute to the total dB reading. Isolating your engine from the rest of the airframe (at least to some degree) decreases noise that's generated by airframe vibration.

VIBRATION

Isolating the many power pulses produced by your engine will make your airframe last longer. Think about it, you wrap foam around your receiver to protect it from vibration because vibration is a bad thing; it "eats" radios, contributes to flutter and loosens parts, such as screws. In many cases, when you use an isolation mount, you can build a lighter airframe because the engine won't try to shake it apart. Let's see now; you can build a quieter, lighter airplane that will last longer! Hmm…sounds good to me!

Here's a guide to some of the most popular iso-mounts available.



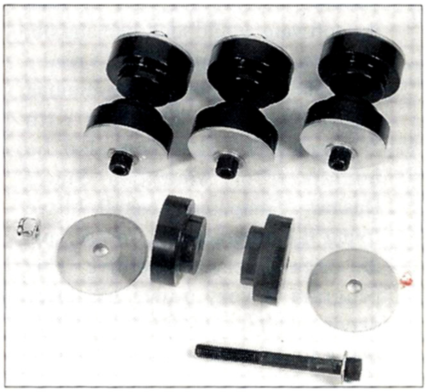
Davis Model Products

For a strong, light setup that will effectively reduce vibration, use the Davis Model Products SoundMaster aluminum engine mount and their blind insert soft mounts. The inserts are adjustable and control the damping, and they're very easy to install. The mount is machined out of a bar of aircraft-grade, 6061-T6 aluminum alloy and is lighter than a cast-aluminum mount. It's available in three sizes for .60 2-strokes, .60 to .90 4-strokes and larger 1.20 4-strokes. It also fits .90/1.08 and 1.20 2-stroke engines.

■ **Davis Model Products,** P.O. Box 141, Milford, CT 06460; (203) 877-1670.

Cirrus Ventures

Scale Aviation USA engine-vibration isolators are available in various densities and use a through-the-firewall mounting bolt for secure installation. Their 5/8-inch seating diameter provides good absorption of torsional vibration, and the large machined

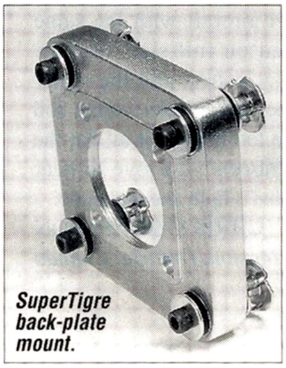


washers support most popular engines well. The mounts are available in sizes for 20cc to 40cc, 40cc to 75cc and larger sizes.

■ **Cirrus Ventures,** 115 Hunter Ave., Fanwood, NJ 07023-1030; (908) 322-7221.

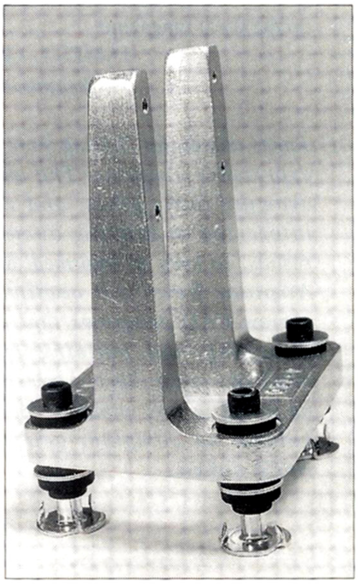
J'Tec

These polished, cast-aluminum iso-mounts come ready to mount and are available in a variety of sizes with long and short arms for .20 to 1.20 engines. They come drilled and threaded for most popular engines. Giant-size, gasoline-engine mounts for Zenoah and Quadra engines are available. You can also get Snuf-Vibe isolation mounting kits separately for use with other mounts. A backplate mount version for .09 to 1.08 sizes and SuperTigre 2500 and 3000 engines is also available.

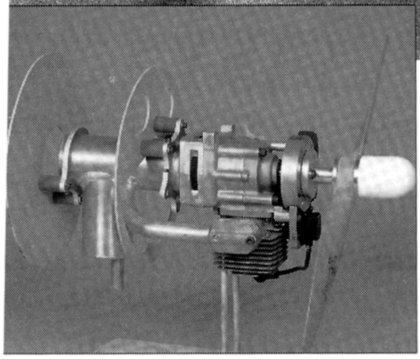


SuperTigre back-plate mount.

■ **J'Tec,** 164 School St., Daly City, CA 94014; (415) 756-3400.



PHOTOS BY WALTER SIDAS



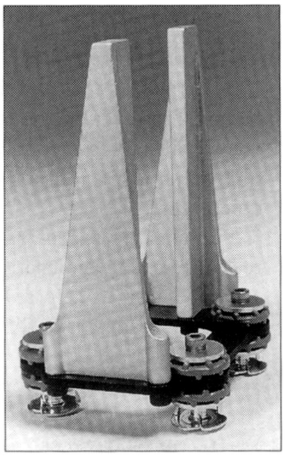
Byron Originals

A combination muffler and engine mount, the Byron Originals PurrrPow'r (shown here with their Mustang 50 gasoline engine) is both an iso-mount system and an effective muffler. The mount has a unique 2-former mounting design, and its length and rotational position can be adjusted. It's available for the Mustang 50, the Quadra 52, the Zenoah G-62 and the Byron/Precision Eagle 4.2.

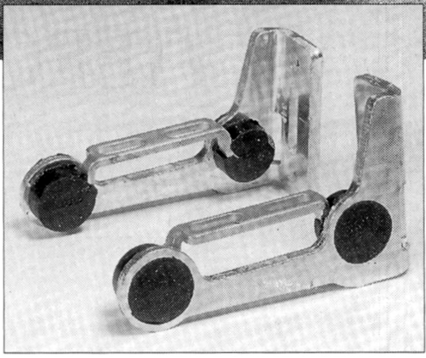
■ **Byron Originals Inc.,** P.O. Box 279, Ida Grove, IA 51445; (712) 364-3165; fax (712) 364-3901.

Gator R/C Products

The Gator Soft-N-Safe mount for 1.20 4-stroke engines uses two-piece, iso-damped, ribbed grommets, which are supported by internally mounted aluminum bushings and large-diameter aluminum washers. The mount comes with firm grommets, unless you request soft ones.



■ **Gator R/C Products Inc.,** 3713 Pompano Dr., Pensacola, FL 32514; (904) 494-0203; fax (904) 494-0207.

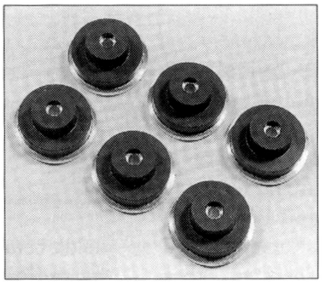


Sullivan Products

This lightweight engine mount has a separate firewall mount and engine beam that are connected with a permanently bonded rubber vibration damper. The aluminum and steel Dynamount is very easy to install and doesn't need to be drilled or tapped to be mounted on your engine. It's available in two versions for .35 to .65 2-strokes; versions for .60 to 1.50 2- and 4-strokes will be available in early '96.

■ **Sullivan Products,** P.O. Box 5166, Baltimore, MD 21224; (410) 732-3500; fax (410) 327-7443.

B&B Specialties

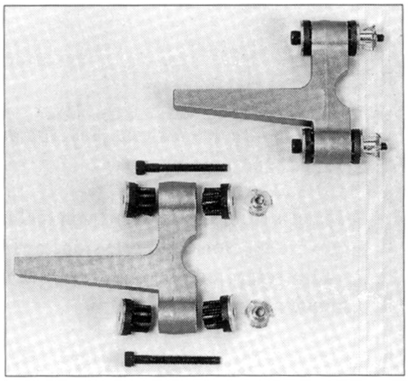


These rubber and aluminum firewall inserts have been around for a while; they're used most often in giant-scale, gas-powered models. Available for most gas engines, such as the Zenoah G-62 and G-38 and the full Quadra line, these inserts work very well with B&B's cast-aluminum engine mounts and others on the market.

■ **B&B Specialties,** 14234 Cleveland Rd., Granger, IN 46530; (219) 277-0499.

Du-Bro Products

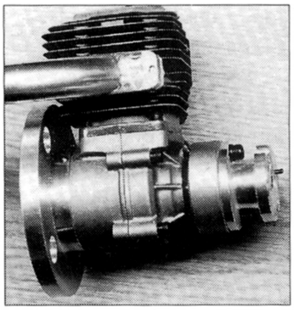
Du-Bro's new, cast-aluminum, vibration-reducing engine mounts have unique elastomeric inserts that accept the mounting bolts. They're available in a variety of sizes for .25 to 1.20 2- and 4-stroke engines. The replacement elastomeric elements are also available separately.



■ **Du-Bro Products Inc.,** 480 Bonner Rd., P.O. Box 815, Wauconda, IL 60084; (708) 526-2136; fax (708) 526-1604.

Ampliflow Co.

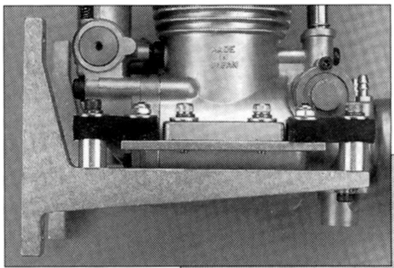
The EMS-T-6 (Engine Mounting System for the T-6) is designed for Madera T-6 Texan race planes—specifically for the Zenoah G-62 engine, which is the specified engine for the T-6 race class. The 6061-T6, aluminum-alloy mount is isolated from the firewall with four rubber vibration eliminators and is recessed so that it will clear the rear-mounted spring starters. A raised boss on the mount's firewall side is sized to fit the hole in most popular T-6 Texan kits' firewalls.

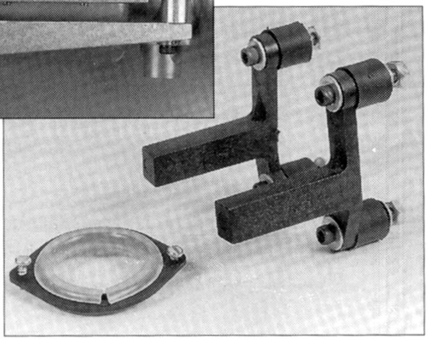


■ **Ampliflow Co.,** 4103 Elrovia Ave., El Monte, CA 91732; (818) 444-8611; fax (818) 442-3553.

Performance Products Unlimited

The Vibra-Sport and Vibra-Damp mounts are designed for the serious competitor and the sport flier. Their designs place the vibration isolators around the engine's center of mass for greater support, so they reduce engine shock forces on the airframe structure. The Vibra-Sport will retro-fit into Goldberg and Midwest sport airplanes using .91 to 1.20 engines. The easy-to-use mounts are drilled and tapped for YS .91AC, all YS 1.20s and Saito 1.20s and 1.50s. The Vibra-Damp can be connected to hardwood beam rails or a 3/16-inch crutch. (A 2-stroke mount is also available.)

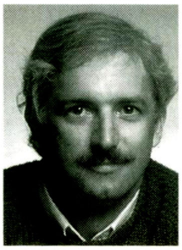




Left: 4-stroke mount; below: 2-stroke mount.

■ **Performance Products Unlimited,** available through Dave Brown Products, 4560 Layhigh Rd., Hamilton, OH 45013; (513) 738-1576.

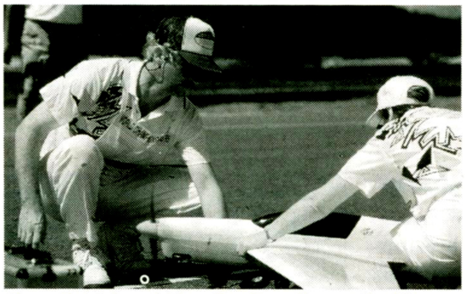
AEROBATICS MADE EASY



DAVE PATRICK

THE WORLD PATTERN CHAMPIONSHIP

THIS MONTH, I'd like to depart from the usual "how to" article and talk about the '95 World Pattern Championship in Japan, which I attended as a member of the Canadian national team. The '95 event saw by far the highest level of competition ever, and I think that all of modeling will benefit from the new, proven technologies, e.g., noise suppression, airframe radio setup, engine setup, flying technique and style and quality.

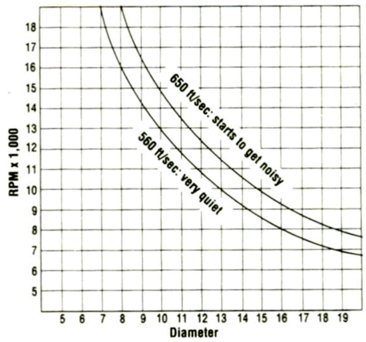


Dave Patrick and his wife, Sue, fire up the Finesse 120 in the finals.

LOW dB

F3A rules provide a strong incentive to be "quieter" than average during flight, so the other members of the Canadian team and I have tried to develop and test many different ways to quiet our aircraft. We found several ways to successfully achieve this and, in fact, I did receive a bonus on my flight score for being extra quiet. These techniques are not difficult to master, and every one helps a bit and adds to very quiet flying.

Propeller tip speed can make a real difference. The chart in Figure 1 can be used to help reduce noise and thus possibly save flying fields. Simply select the prop that yields the best performance on your particular aircraft.



RPM TIP SPEED AND SOUND LEVELS

560 ft/sec Dia	RPM	650 ft/sec Dia.	RPM
8 inch	16,000	8 inch	18,550
11 inch	11,700	11 inch	13,500
12 inch	10,700	12 inch	12,500
15 inch	8,550	15 inch	10,000
19 inch	6,750	19 inch	7,850

Formula: $\frac{\text{Diam. x 3.14285 x rpm}}{12 \div 60}$ = feet/sec.

Figure 1

Soft mounts can also reduce airframe noise. During many practice flights, we've found that non-captured mounts that don't limit engine movement, are the best. Technically speaking, the damping curve should be fairly linear and unrestricted, without the sharp increase at the extreme limits of movement. MK* and Performance Models Products* manufacture non-captured mounts. There are other benefits to these mounts besides being quiet; the main one is that they suppress the powerful shock forces of the inherently unbalanced single-cylinder engine. Also, its detonation is damped. There's virtually no power loss (contrary to what some people think), and the harsh load placed on the airframe is dramatically reduced.

Keeping this in mind, the airframe can be engineered to be lighter, and this yields better flight performance. Even the radio performance—especially servo pots and gear life—is dramatically improved. The 4-stroke engine can be very hard on an airframe, and the airframe can really benefit from a good, soft-mount setup.

FUEL

The correct fuel has a bearing on both performance and noise. First, let's assume that more power generates more noise. Basically, the higher nitro fuels yield more power when used properly. The more nitro used, the greater the necessary "deck height" (clearance between the top of the cylinder and the engine head).

To determine whether you need to make an adjustment in a 2-stroke engine, simply listen for a crackling sound; this can be

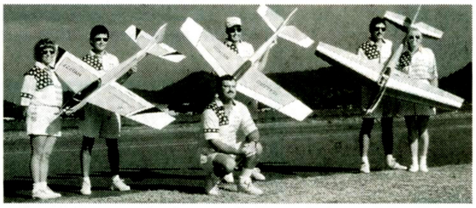
RESULTS—1995 WORLD PATTERN CHAMPIONSHIP

Pos.	Pilot	Country	Plane	Engine	Prop	Radio
1.	Giichi Naruke	Japan	Arum Z	O.S.	141/2x13	Futaba
2.	Wolfgang Matt	Liechtenstein	Opal	YS SC	15x12	Futaba
3.	Christophe Paysant	France	Top Line	YS 120 AC	—	Futaba
4.	Hajime Hatta	Japan	Explorer	O.S.	14x13	JR
5.	Yoichiro Akiba	Japan	Wild Beat	120 SC	141/2x13	Futaba

Team

1. Japan—Giichi Naruke, Hajime Hatta and Yoichiro Akiba
2. France—Christophe Paysant, Benoit Paysant and Laurent Lombard
3. Canada—Ivan Kristensen, Dave Patrick and Colin Campbell

an indication of "pre-detonation." This is fixed either by reducing the fuel's nitro content or by adding a few head gaskets to lower the compression ratio. In a 4-stroke, pre-detonation sounds as if the engine is hammering or "knocking." The fix is to add a couple of head gaskets (be sure to adjust valves if necessary). It is particularly important to get this correct on a 4-stroke, because pre-detonation can dramatically reduce the life of the engine. So fixing a pre-detonation problem will not only make your engine quieter, but it will also make it last longer and reduce its operating cost.


The USA team looks good. From left to right: Diane and Chris Lakin, Bill Cunningham, Dave and Janelle Von Linsowe. Team manager Tony Stillman kneels in front.

Overheating is another indication of pre-detonation, and it's sometimes hard to determine because it can be caused by other things. This is an important point to keep in mind.

We discovered that a YS* engine with a properly set 15x12 APC* propeller, needle setting (rather rich), deck height (about two more gaskets) and about 30-percent-nitro fuel gave us tremendous, yet quiet, power for our 9.5- to 10.5-pound pattern ships.

Mufflers are important, but not as important as you may think. A few people have used carburetor-intake box mufflers, but we feel the gains were almost negligible. A good Hatori* or a similar type on the 1.20 4-stroke, will do a fine job of silencing the exhaust.

RADIO SETUP

Although many sport fliers seem to fear computer radios, for competitors, they're a necessity. But it's also true that the modern computer can really help the sport flier fly better and with greater ease. These radios also make good economic sense because they have the capacity to store the control setups for many models.

In F3A, we try to make full use of these features. On their 9 ZAP, Futaba* has a very powerful feature called "Conditions." Once understood, this feature can help improve your flying. I'll try to explain: most of us understand the commonly used dual rate—a switch that can desensitize the controls for smoother handling during maneuvers, such as the slow roll (low rate). At high rate, you have the control authority for maneuvers, such as spins and snaps. Great, but can you imagine that, with a flip of a switch, you can change any adjustment of the radio! Example: condition no. 1 can have different throws on all controls and different expo values for, let's say, the reverse spin; then condition no. 2 for regular flying can have a totally different setup.

FLYING

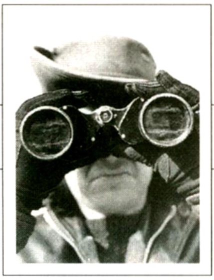
The team in Japan was a talented group, and while we Canadians took the gold in 1992, we only ended up with a bronze medal this year. The biggest difference for us was that the level of competition was extremely high. It was obvious to us that just making the finals was a major accomplishment.

As for style, it seems that a very "soft" style with slow rolls and very slow horizontal passes was the ticket. Throttle management was used constantly and very well by the top fliers.

Contest director Mr. Tsugutaka Yoshioka and the Japanese team should be congratulated for an extraordinary job of organizing this year's championship.

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

AIR SCOOP



C H R I S   C H I A N E L L I

New products or people behind the scenes; my sources have been put on alert to get the scoop! In this column, you'll find new things that will, at times, cause consternation, and telepathic insults will probably be launched in my general direction! But who cares? It's you, the reader, who matters most! I spy for those who fly!

New SR Cells and a Motor Saver

Continuing their tradition of providing high-quality products to the electric flight market, SR Batteries has announced two new cells—and a shaft protector/extender—for competitive electric fliers. The new 1800 Max, a full Sub-C cell (.9x1.69 inches, 1.86 ounces) costs $6.50 each, or $9.50 per cell in a finished, wired, matched pack. The new SR 1200 Max LMR (1.02x1.18 inches, 1.49 ounces) is designed for limited-motor-run events and may be the cell to beat this year. Both cells combine high capacity with low internal impedance.

SR's new shaft protector (mounted here on an SR Max Series Motor) cradles the motor shaft in a precision ball bearing to protect it from hard landings. At $19.95, the shaft protector is less expensive to replace after a hard landing than a motor or armature. It's compatible with 8mm prop hubs and comes in 4mm (Astro) and 3.2mm (1/8 inch) versions. For more information, contact SR Batteries at Box 287, Bellport, NY 11713; (516) 286-0079; fax (516) 286-0901.

Stika Stick-Ons

Wouldn't it be nice if you could cut your own vinyl stick-on decals and graphics? How about having your own scanner to scan in images?—and having it all for less than $300? Well, the Stika vinyl-cutting machine does all this, and you don't need a computer to run it! Sound impossible? Read on.

This small (it can be held in your hand), high-quality scanning and cutting tool is made by the Roland Digital Group and distributed by Sky Aviation. It comes with all the necessary operating software, instructions and interface cable for Mac and IBM PCs. With the software and a computer, you can create very specialized graphics and letters, and on the bottom of the unit is a scanner head that can be used to duplicate graphics. You can use the zoom feature to increase and decrease the size of the scan, and you can even make mirror images (great for painting masking material). The cutting head uses a stylus cutter and can cut graphics up to 2¼ inches wide (and as long as you want). You can use any type of decal material, including MonoKote and Coverite Graphics trim sheets. Creating stick-on graphics has never been easier! Contact Sky Aviation, 1320 Gay Lussac St., Ste. 106, Boucherville, Quebec, Canada J4B 7G4; (514) 449-0142; fax (514) 449-0144.

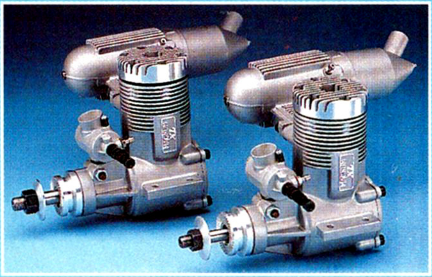
Known for their high-quality, plastic, miniature, military models, R/C cars and sailboats, Tamiya has now sprouted wings and taken to the air. Their new Peak Spirit RU electric-powered R/C glider is state of the art and is powered by a Dynatech electric motor. The 78½-inch-span glider has throttle, elevator, rudder and spoiler control and weighs only 3⅓ pounds. It's equipped with a folding prop to reduce drag, and the spoiler/dive brakes are proportionally controlled for precise landing approaches. A light gearbox and a spring-loaded wing attachment system are also included. Radio and speed control are not included. By land, sea and now by air, Tamiya soars. For more information, call Tamiya America at 2 Orion, Aliso Viejo, CA 92656-4200; (800) Tamiya-A; fax (714) 362-2250.

TAMIYA TAKES TO THE AIR

TORNADO ALERT

Global has taken the advanced trainer to the next level with the Tornado AT. Its wing panels are already joined, the control hinges are glued into place, the fuselage is ready for the wing to be bolted down, and the model is covered with CGM Ultracote. A Magnum XL-40, XL-46, or XL-53 engine will drop right into its *drilled,* aluminum engine mount. Fixed, fuse-mounted trike gear simplifies construction (no retracts to install). The Tornado AT comes with everything, including fuel tank, landing gear, wheels, spinner canopy and detailed, photo-illustrated construction manual.

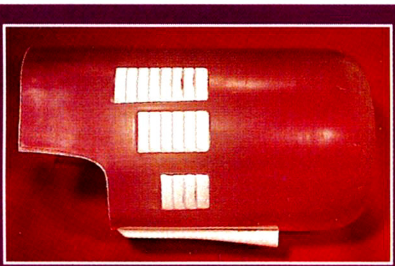
Also from Global are two more powerful engines to add to their Magnum line. The ABC XL-91 and XL-120 include FSR porting and dual-ball-bearing support. These reasonably priced, reliable engines feature dual-needle-valve carbs and are for modelers who want value and performance from large to giant-size models. Look for these early in '96. For more information, contact Global Hobbies at 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.



OPEN ROADS OF AFRICA

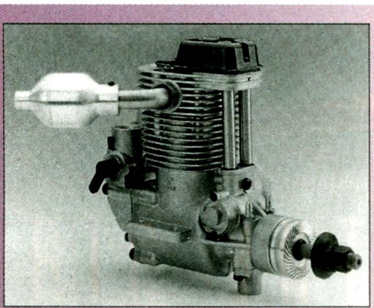
Built by Chris Freeman, an employee of South African Airways' Corporate Relations Department, this fun-looking, giant-size AMA Delta Dart has a 50-inch span and uses a 3-channel radio (rudder, throttle and elevator). It's powered by an O.S. .10. Named "Vulindlela" (the Zulu word for open roads), the model is very stable, yet it loops and rolls very easily. Our thanks to international modeling contact and assistant spy Frank Garcher of Midwest Products for supplying this photo. (Does this make rubber-powered Delta Darts "scale" models?)

Aftermarket Makeover



Aeroglass's top-quality fiberglass cowls, wheel pants and landing gear are now available in the USA. They're made of isophthalic polyester resin and two or more layers of 6-ounce fiberglass cloth. Parts are available for most Goldberg and Midwest kits. Twenty cowls, eight wheel-pant sizes and five landing-gear sizes are available from Sheldon's Hobbies, and 1/4- and 1/3-scale Cub cowls are available from Balsa USA. Meister Scale handles Aeroglass cowls to fit their plans and kits. For more information and prices, contact Stephen Weber, Box 24, Port Rowan, Ontario, Canada N0E 1M0; (519) 875-1533.

YS120NC—SUPERCHARGED!



This new 4-stroke from Futaba is designed for pattern, scale and large sport models and is an upgrade of their popular YS120SF engine. It has a new cylinder head with a bigger intake valve, new valve-retaining clips and a new front-bearing oil seal. Like the YS120SF, the 120NC uses the proven YS supercharger and fuel-injection systems for plenty of power and great throttle response. Specifications: bore—30.4mm; stroke—27.5mm; displacement—19.96cc; weight—950 grams; practical rpm—2,000 to 12,500. For more information, contact Futaba Corp. of America, P.O. Box 19767, Irvine, CA 92713-9767; (714) 455-9888; fax (714) 455-9899.

Revisiting a bygone era

Hobby Shop M

by DAVID M. DANIELS

Author today: still seaplanes! Electric, scratch-built Grumman J2F-2.

Author with an almost complete Loening Amphibian.

WE ALL HAVE FOND memories of that place of endless fascination, that temple to things aeronautical, that repository of our dreams; and the money—hard-earned from endlessly shoveling sidewalks to earn the cash that we so eagerly spent at that place—aah...the local hobby shop. My local hobby shop is Ed Aussiger's Modelcraft Hobby Shop in Rutherford, NJ.

In Ed's showcase reposes that jewel—the Mighty Atom engine (far more desirable than the Eye of the Buddha, the British Royal Scepter and a jeweled Coronation crown). Ah, the lines of it! What grace! What fins! And, what genius decided to fasten the gas tank directly *under the crankcase*? The teardrop sweep of its translucent configuration, the wire clip that holds it securely in place—sheer poetry. To say nothing of the gleaming spinner prop nut. Way ahead of its time! With Ed's kind indulgence, a lovingly slow turn of that spinner caused magical things to happen: the tiny silvery piston could easily be seen as it rose to where these eager fingers could feel the mystery of compression that would, perhaps, one fine day power a Comet "Zipper" into the very stratosphere! (oh, the very thought of it). Less dramatic, perhaps, but just as exciting to me, the "points" could be observed slowly opening and closing as the spinner was turned farther. The little "plop" as the piston came all the way down—music to the ears! The "heft" of the coil (not thought to be "really" heavy); the shiny aluminum condenser and the battery box! Realistically, of course, none of us could afford much more than a cheap Megow or Guillows kit and a small tube of Ambroid, but no matter. Cliffie Crawbuck and I had our dreams. Chet Bernhard and Harrison "Chips" Wood (who would, a few years later, take flying lessons with me at Tony Barone's Little Ferry Seaplane Base), were in the same boat at the time.

One day, what's this? Holy Cow! There's a sign in Ed's window! What does it say? "Dad, I couldn't read it, 'cause you drove by too fast. Aw, please, go around the block once, so I can see it. *Please!* Aw, thanks a lot." I thought sardonically, as Dad drove blissfully and regally on in our Nash Airflight.

I could always leave the house early in the morning, before school, and pass by to check it out! It couldn't be the unthinkable, could it? Oh, geez, could Ed be closing the store? No!—the thought was too painful. Where would I ever get a "Mighty Atom" if Ed ever gave up the store? Would I ever get to fly a "Zipper"? No, there would be no cowl; not even the recom-

The ol' gang with a Luscomb "Silvaire" (author on left).

mended "cheek cowls" to obscure the world's appreciation of the beauty of that "Mighty Atom" engine, resplendent in its pristine beauty, bolted to spruce mounts projecting through that red-ply firewall. I figured that red and aluminum were complementary colors. Some things like this were so self-evident that it wasn't even a matter of conscious thought. It was a truth—like the Golden Rule or E Pluribus Unum or the Ten Commandments; it had always existed—maybe before recorded time or the Pyramids or General Motors!

In a PT-19. Too expensive!—probably $18 for a half hour of instruction.

Author with Miss America (Atom-powered).

Oh, joy! Oh, rapture! The morning sun reflected on Ed's message, which was certainly as important to us all as any old stone tablets, I thought, rather irreverently and guiltily.

Notice: those interested in forming an Aussiger's Modelcraft Shop Club: meeting at 7:00 p.m. Tuesday.

Amphibian with "Atom" engine, in Rutherford, NJ.

I couldn't believe it; Ed was starting a hobby club!

Oh, hey, wow! Wait'll I tell the guys about *this*! The magic words were etched and burned into my memory. To be certain, I traced the lettering through the glass just to be sure I wasn't dreaming. No, it was real, genuine, the glow over Orient Way was bright—a truly glorious day. It was going to be a very fine day, a most unusual day. Wait a minute! This was only Friday! An accursed weekend loomed ahead, and two full school days were to be endured (although The Shadow, "Who knows what evil lurks in the hearts of men? The Shadow knows!" was on Sunday, and Miss Page's great science class, "It is pronounced car-bu-re-tor, not karberater"...made the wait somehow more palatable).

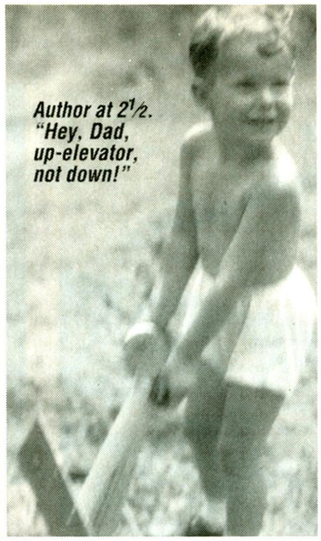
The magic day finally arrived! Tuesday, 5:30 p.m., and supper was almost consumed. As I recall, it consisted of lamb chops, string beans from our garden, applesauce and rice pudding with raisins. They say that you never forget the details of exactly what you were doing at the time when momentous events such as the moon landing, the Kennedy assassination, Bert Rutan's Voyager circling the world on one tank of gas, occur! Must be right! I needed time to walk and run to the first meeting at Ed's. Being late was absolutely out of the question! Thank goodness I had already obtained permission to go to the meeting. Planning ahead was not one of my strong points. 5:50 p.m.! The countdown was on. I figured that I could get to Ed's in about 20 minutes walking or 10 minutes running. After all, it was only a matter of two blocks on Mountain Way, down that great sleigh-riding hill (have you noticed that with today's salt and sand spreaders, that nice, packed street snow is gone) to Orient Way, then a straight shot of five blocks past Bell Tel and The Town Talk restaurant and then to the shop.

Should I bring anything with me? An as-yet-unfinished Guillow's "Hawker Hurricane" was a good choice; I was very gratified with the general progress I had made. It was small, though, because it was a 25-cent kit and rubber-powered at that. I thought maybe the guys would consider it a bit "chintzy." Would the guys bring anything? I didn't know. I hadn't asked when I told them about the announcement in Ed's window. Chet was presently building a "Brooklyn Dodger" for his old Brown engine; although he coveted mightily the Ohlssen "60" we had recently seen in Bamberger's Newark store, with it's full 40-foot counter, devoted to nothing but model supplies! A glorious journey for these two adventurers. William (Bud) Barry would come (probably early) to the meeting. Lucky guy; he lived only a couple of blocks away. (Bud went on to Fairleigh-Dickinson College, my almamater, and then to Annapolis and a distinguished career as a Naval aviator.) Only last week, we had BB-gun target practice firing at Coke bottles in his dad's empty garage. I remember at the time his mentioning that it would be really great if there were a hobby club in town. Was he psychic? Vinnie (Parsons) Freston, my best buddy for many years, would

"Out of uniform" (no tie!). The author posing with C.A.P. Cub.

most certainly attend. He wasn't a "joiner"; a fault he later came to regret when I became Cadet Commander of Rutherford's Civil Air Patrol squadron, based at Rutherford High School and started taking flying lessons at Tony Barone's Wurtsboro New York field.

When did my interest in all this begin? Was it my Mom, struggling to carve and complete a 10-cent Guillow's solid model of a "Curtiss Robin" to entertain me while I lay in a Brooklyn hospital recuperating from an appendectomy? (I figured at age seven, I could do a lot better.) Was it that after-school visit to Donald Hugo's house (this was considered by most of us to be quite an honor, because Donald's dad was Mayor of Rutherford at the time). A dim, musty cellar, smelling faintly of coal gas, when what to these astonished eyes should appear but the magical framework of a dusty, half-finished very large Boeing P-26E "Peashooter." I recognized it immediately! I think the fairing that supports the headrest behind the open cockpit was the clue. Would I be permitted to "heft" it? Yes. Incredibly light. The rear fuselage hook gave it away as "rubber-powered." Large, though! Would take many strands of ⅛-inch flat to power that. What? You can get ¼ inch? Didn't know that! A gem. Why wasn't it finished? And flying? Donald never did answer that one—a sin!



Author at 2½. "Hey, Dad, up-elevator, not down!"

Vinnie Rennert was probably not going to be at the meeting because he was planning to run away. He had been rummaging through some drawers at home when he found copies of his adoption papers. He hadn't known he was adopted. Tough for a guy his age to discover such an important thing in such a manner.

John (Ditzy) Ditzenberger was more into softball than airplanes, so I was only half expecting him to show up, even though he always wanted to accompany us to the field over in Delawanna whenever we were flying. Nice guy, but more of a "looker" than a "builder." Henry "cat-face" Hartmann, who would later become Minister of Rutherford First Presbyterian Church, had said he would be a member of Aussiger's club, but he didn't think he could be at the first meeting. We'd all miss him. Great guy—not a mean bone in his body. Just as well for a future preacher, I guess. Eddie Bower, whom I had kidded now for about two years about the dime he owed me, had fallen out of a tree on Ettrick Terrace a couple of days ago and broken a front tooth when he hit the sidewalk. We could follow, for months afterward, the indelible drops of blood that stained the concrete walk all the way to his house on Sylvan Street. He would also probably miss the first meeting or two! His folks were very mad at him for messing himself up and costing them so much money. Not an unreasonable attitude, I thought.

"Hey, Cliffie. Naw, I'm going right in!" Cliffie wanted to "hang" for a bit to finish his popcorn. Cliffie always had a weight problem, I recall. He went on to be an electrical engineer—holds a couple of patents, I believe.

"Here comes Chet Bernhard now. What's he carrying? It's the body of his Brooklyn Dodger. Not covered yet. Looks great, though. Zillions of stringers, just about!" Chet still holds the high school rope-climbing record, even after all these years. He had to shovel tons of coal over a coal-bin partition every a.m. before school to help his dad who was a large-apartment-house super. He could go up the rope in a flash!—no feet at all. He could "chin" himself fifteen times, one-handed—either arm! Too bad he never did have the time to go out for sports, though. All the high school coaches would have given their eyeteeth, or their Phi Beta Kappa keys, to get him on their teams. Do high school coaches have Phi Beta Kappa keys? In all the years I taught science and as a high school administrator, I never saw any school athlete with the potential of Chet Bernhard. Sometimes things just don't work out.

"Here comes Chet Bernhard now. What's he carrying? It's the body of his Brooklyn Dodger. Not covered yet. Looks great, though. Zillions of stringers, just about!"

"Bud" Barry and "Chips" Wood were already inside the tiny workshop meeting room. Ed had taken the time to post a sign: "Please do not touch the tools and engine repair parts!"—not that we would, anyway.

"C'mon, Cliffie, finish the popcorn, and let's get in to the meeting!" Instantly the guys surrounded poor Cliffie. The popcorn was very rapidly no longer a problem. Vinnie (Parsons) Freston's dad was just dropping him off at the corner, and I could see the outline of his new Korda "Wakefield," a huge, flat-sided, rubber-powered endurance model. It had a folding prop, and you could see the outline of the powerful rubber motor through the translucent-yellow silk covering with red trim. Neat! Vinnie had discovered that buying ladies' silk scarves for covering was much cheaper than the "model silk" that Ed sold. Ed was not too happy about that fact, but there was little that he could do about it rather than reduce the price of his silk, which he later did.

Vinnie hated his middle name—Parsons—so naturally, when we found out, we called him "The Parson" at every opportunity. Eventually, he learned to live with it. Vinnie was planning to enter his plane in the Hobby Show at the First Presbyterian Church Parish House on Park Avenue. He took first prize!

One guy's dad, who shall remain nameless, wryly muttered that, "Only bums hang around hobby shops. What can you learn there?"

Ed's voice at last rang out the front door, "OK you guys, meeting's starting."

Indeed—indeed—indeed! ■

"Atom" strikes again.

Vin Freston's "Varsity."

HOW TO

Master slow flight

Minimum Controllable Air Speed

This Antonov AN-2 Colt is the largest single-engine biplane in the world. Here, it demonstrates minimum controllable air speed with its flaps deflected and a positive pitch attitude. Believe it or not, with all of its slotted flaps down, power reduced and up-trim added, this plane can fly almost as slowly as a Piper Cub.

by ROGER POST JR.

HAVE YOU ever flown a hot, new ship for the first time and realized that your approach speed is too fast for landing? Establishing and maintaining a slow air speed, i.e., minimum controllable air speed (MCA), is easier than you think. You can achieve this by experimenting with power and trim settings, practicing at a safe altitude and using the rudder. There's nothing more enjoyable than flying a landing pattern just above the deck and shooting touch-and-go's at MCA.

Here are a few hints that can help you slow down your plane and land it safely.

FIRST FLIGHT

When you test an aircraft's flight performance for the first time, don't blast the plane down the runway and lift off. If you've overlooked something, e.g., a warp in a wing or too much flexing in a control cable, the plane could crash on takeoff. If it's moving too fast, you may lose control; your thumbs won't be able to anticipate this errant flight path, and down goes the plane.

A buddy of mine uses a technique that's almost foolproof for that first takeoff. He looks the model over and determines what the minimum air speed would be to take off; then he uses just a slightly faster speed for the takeoff run. If anything goes awry after liftoff, the plane will be going slowly enough for him to control it and bring it back to the field safely.

Many factors determine the minimum flight speeds of a model: weight, CG, engine size, thrust from engine, and aircraft design (airfoil, wing position on the fuselage, wing planform, amount of dihedral, tail design, wing loading and structural integrity, just to name a few). He continues the climb-out and procedure turn under partial power, trimming as he goes, and then he flies the plane to a maneuvering altitude. When he's sure that there won't be any erratic behavior, h gradually pours the coals to it, r trims and wrings the plane out.

NOW IT'S YOUR TURN

• First, advance the throttle t about $\frac{1}{3}$ power, and see how th plane reacts as it goes down th runway. If there seems to b enough power to make the plan fly, leave that setting, and let th plane climb out while you contr pitch, bank and yaw. You ma need a little more power or, perhaps, a littl less power; if so, make the power change a little at a time.

• Second, when you're flying at slow a speeds, use the rudder with the ailerons t turn the plane. Because of the airflow ove the tail surfaces, the rudder is the mos effective control surface at slow air speed and it will help the plane correct an adverse yaw or unsolicited wind inputs.

• Third, use small control inputs, especially whe it comes to any kind of pitch change, e.g., up elevator. Pitch controls air speed, and any larg amount of up-elevator input could slow the ai speed further and place the plane in a stall. Yo may find yourself holding some back pressure o the elevator stick; this is a direct result of the slov air speed. This is dangerous and can be alleviate by using some up-trim. Throttle changes and pitc changes go hand-in-hand when you're setting u for wings-level slow flight.

When you're in the air, gradually pull th throttle back, and feed in some up-trim. If you plane has flaps, deploy them gradually, an adjust the elevator trim as necessary. You'll hav to experiment with these inputs to find the bes slow speed for your particular plane. The plan will have a higher angle of attack than usual, an there will be quite a bit of downwash and induce drag associated with this flight attitude. Here i where it's absolutely necessary to fly the plan with the rudder.

Now that your plane is crawling along in th sky, practice flying horizontal figure-8s at a saf altitude. When you're comfortable with this, fl landing approaches. With the slow air speed you'll be able to groove a landing, land on the firs third of the runway and never overshoot it again If you find yourself landing short of the runway add a little power. Power is altitude. Eventually you'll be winning all of the spot-landing contest at your field and smashing fewer planes because o a too-hot landing speed.

Good luck, and use your rudder. ■

A stroll through aviation's most famous neighborhood!

by BUDD DAVISSON

The Eagles Aerobatic Flight Team—Gene Soucy (wing), Charlie Hillard (leader) and Tom Poberezny (wing)—tight and close. 1995 is the final year for the team; they're retiring after 25 years of nonstop air-show work.

Oshkosh '95

BY THIS TIME, most flight-line warriors who survived the battle of Oshkosh '95 have begun to recover. Their feet no longer hurt. The cricks in their necks from looking in every direction at once, but mostly up, have gone. They've regained most of their energy and no longer feel drained by the constant flow of adrenaline. They've forgotten the constant trudging up and down the flight line. They have rejoined society and are no longer part of the Oshkosh walking wounded.

Enough time has elapsed since that annual aeronautical "Woodstock" so the recovering warriors no longer wander around aimlessly, speaking to any who will listen about Oshkosh '95. Instead, they babble on endlessly about their plans for Oshkosh '96. They know, as so many have found before them, that Oshkosh is not a destination. It's an addiction. They will return. They must return. They can't help themselves.

OSHKOSH, THE NEIGHBORHOOD

Oshkosh, the fly-in, with its ridiculously high statistics (50,000 campers, 830,000 attendees, 15,000+

At Oshkosh, the field of golden-age racers included (front to back): Jim Younkin's Travel Air Mystery Ship, his Howard "Mr. Mulligan" and Jim Clevenger's Model 44 Wedell-Williams. (Photo by Budd Davisson.)

airplanes, 17,430,000 sheets of toilet paper, etc.) is a city that exists for only a week. As with every city, it has its neighborhoods, and it is the sum total of those neighborhoods that make up Oshkosh. Unfortunately, the sum total is all that those who weren't there will see. They'll see the big picture, the entire happening, only as it is condensed by the media in an attempt to fit seven days of experience into a three-minute news report or six-page article.

Those who were there, however, remember a blur of neighborhoods, each with its own character, language, status symbols and personality. They remember those neighborhoods as mini-fly-ins, each of which could stand on its own as a worthy event.

The most difficult part of getting to know any city and its multitude of neighborhoods is to avoid getting lost, which isn't easy in an L-shaped aerial configuration that spanned nearly two miles north and south and a mile in the other direction.

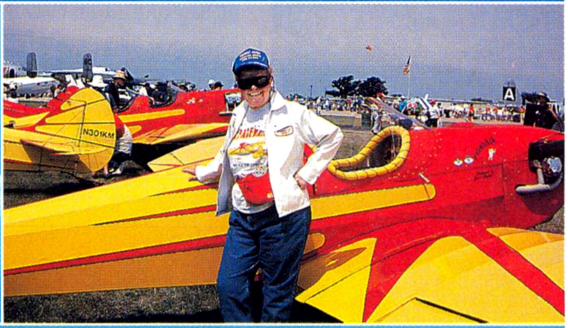
The north side of the "L" has a runway right down the middle of it, and that kept the show planes separated from the transients and was one of the few pieces of flat space at the airport that wasn't covered with flying machines. One out of every eight single-engine airplanes in the country was in attendance!, so the airport couldn't help but be completely carpeted with airplanes. They were squeezed into every nook and cranny of Wittman Field—one of the largest regional airports in the country.

The north side of the east-west runway, the transient neighborhood, housed a large part of the approximately 15,000 airplanes whose pilots came to see, but inadvertently became part of the show. They stretched as far as the eye could see, and even in the transient aircraft parking areas, there were mini-events taking place. For instance, there was the Bonanza neighborhood (Beechburg?), which housed all of the 132 Beechcraft Bonanzas that flew in together. It took nearly half an hour for all of them to land.

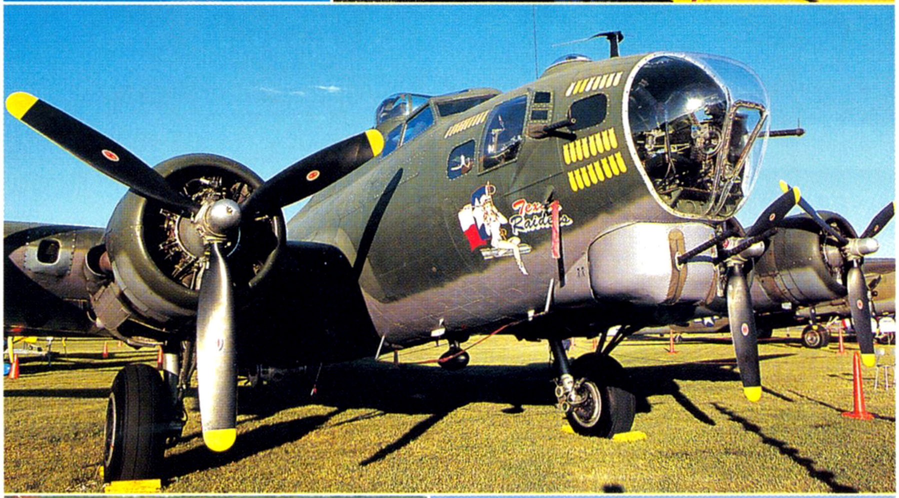
Colorful tents and shelters crouched

"FIFI" is the only flying B-29 Super Fortress in the world—what a treat!

Right: hanging on the prop in a slow knife-edge flyby is Sean Tucker in his highly modified 1-800-COLLECT Challenger Pitts.



Far right: always with a smile, Hazel Sig poses for the camera after landing her homebuilt Space Walker. (Photo by Tom Perzentka.)



A shadow of WW II, the B-17G "Texas Raiders" stands proud against a blue sky. This year—the 50th anniversary of the end of WW II—has brought sharper focus to these and other classic warbirds.

Right: a flying mirror, this highly polished Ryan STA speaks of countless hours of buffing, polishing and elbow grease.

Far right: P-51s at Oshkosh? Are there racecars at the Indianapolis 500?

PHOTOS BY RICH GRAHAM

Above: R/C's own Hazel Sig—owner of Sig Manufacturing Co. in Montezuma, IA—is no stranger to Oshkosh. Here, she's flying her Space Walker homebuilt in the Homebuilt Revue. Right: a fleet of nose-draggers. The Long-EZ and Vari-Eze composite designs are very popular with homebuilders today.

under the wings of $150,000 airplanes, as their owners gave up luxury in favor of being included in the "Oshkosh Experience."

Oshkosh isn't all asphalt and grass; there's a fully stocked seaplane area, as well. Here, some line boys haul in a big catch.

WARBIRDS

Across the runway, the colors became more subdued with olive drab and dark blue becoming predominant. Time was rolled back 50 years to when the hundreds of carefully restored warbirds had been busy doing what they were designed for—fighting a war. Even there, in a decidedly military neighborhood, the smaller events made up the whole.

For the first time in memory, for instance, there were no fewer than five Spitfires lined up wingtip to wingtip. When their distinctive lines flashed down the runway in 300mph passes, hair was standing up on thousands of necks.

Mustangs seemed to go on forever, and the crowd received a rare memory for their collection when they looked up at a full squadron of P-51Ds—16 airplanes—singing their 12-cylinder songs as they passed overhead in tight formation.

Then there was the AT-6 formation with upward of 50 planes, the tight formation of a similar number of T-34s and the gaggle of liaison airplanes that were too numerous to count. As the multitude of airplanes crisscrossed one another, the airport actually did have an aluminum overcast. It has been estimated there were nearly 200 warbirds over the airport at a single time.

But the warbird community wasn't universal in having a propeller on each nose. We have fought more than one war, and the crowd was reminded of that when they saw F-86s chasing MiG-15s down the runway, or saw other jet-powered soldiers from times gone by.

THE HOMEBUILTS

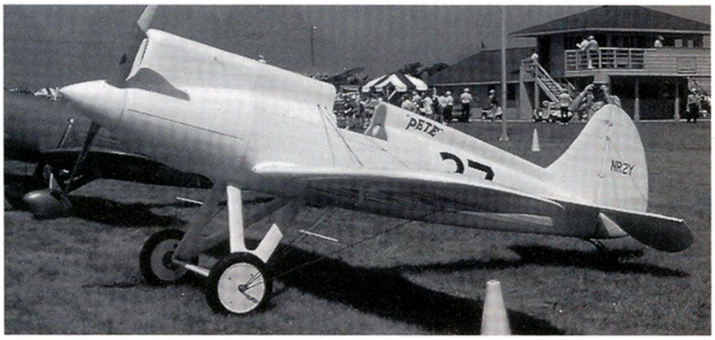
If the newly arrived flight-line warrior entered the grounds through the main gate and waded through the thousands of commercial exhibitors in buildings, tents and corrals, he or she would burst upon the mid part of the north-south flight line, which contained the original heart of the Experimental Aircraft Association—the homebuilts. More correctly known as "amateur-built" aircraft, there was nothing about the hundreds of homegrown airplanes that indicated they were done by amateurs. Perfection was the Holy Grail, and the act of building was the Crusade.

The quality of most of the so-called amateur-built aircraft is difficult to imagine without seeing it. Take the best-detailed, most superbly executed R/C model, move the decimal point over a couple of places, and you'll be close—but only close.

As would be expected, the homebuilt area also comprised a multitude of smaller neighborhoods—or fly-ins. Dozens of Van RV-3s, -4s and -6s huddled together, as did Thorp T-18s and Midget Mustangs. A sea of shark-like fins that jutted into the air indicated where the Vari-Eze and Long-EZ roosted together, their noses on the ground as though they were sleeping while their owners wore themselves out in a vain attempt to see everything on the grounds—clearly an impossible task.

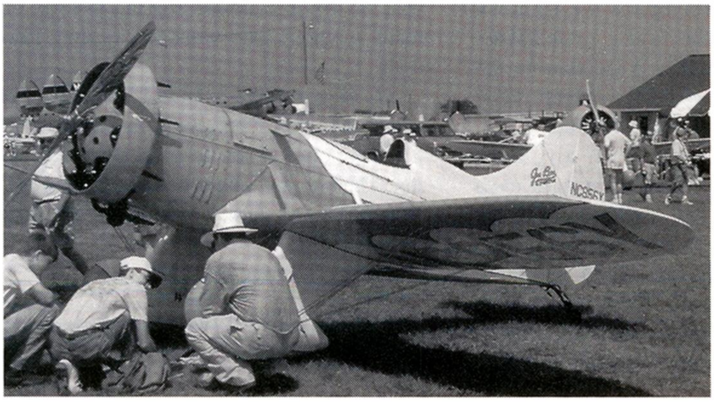
MEMORIES AND TRIBUTES

Sadly, Oshkosh '95 was a gigantic memorial service for the grand old man of air racing and home-building, Steve Wittman. At 92 years of age, Wittman lost his life a few months earlier in an, as-yet unexplained, but non pilot-related, aircraft accident. His immortal design, the Tailwind, was represented by a neighborhood all its own that was populated by brilliant examples of his little two-place, rectilinear bullet.



Golden-age racers are becoming quite popular as replica projects. Made with steel tube construction, they have wooden wings and fabric covering; this pristine Benny Howard "Pete" racer is a beautiful example of the homebuilder trade.

Oshkosh always has a number of themes that focus attention on specific facets of aviation and, along with the memorial to Steve Wittman, one theme this year was the EAA's "Tribute to Valor," which featured ceremonies and flybys to recognize the men and women who fought in WW II. No one there will ever forget seeing a tight, two-ship formation of Mustangs take off with Chuck Yeager flying the lead, and his old WW II wingman, Bud Anderson, tucked in tight on him. It was a time to meet famous warriors of all branches of the service as they spoke at various forums throughout the week.



This Gee Bee model was built by Jim Jenkins of Goshen, CT. It took Jim 4,000 hours to complete this beautiful aircraft, which is powered by a 125hp Warner Scarab radial engine.

PHOTOS BY TOM PERZENTKA

Another major Oshkosh theme featured golden-age air racers. The "golden age" is loosely defined as the 1930s, during which time, backyard speed merchants quickly pushed aircraft beyond speeds that the military could keep up with.

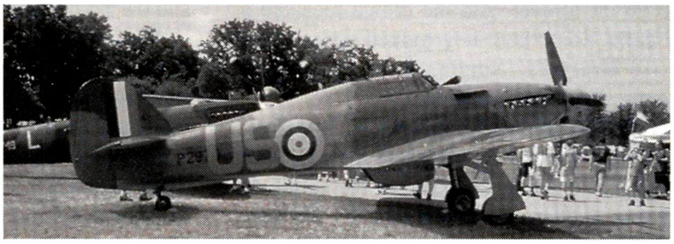
In recent years, the movement to build replicas of golden-age racers has accelerated; this year, there were no fewer than 22 such replicas on the field. The air-show crowd was treated to the rare sight of an R-1 Gee Bee fighting

it out with a beautifully done Mr. Mulligan and a pair of Wedell-Williams racers; the sound of their P&W radial engines was smoothed to a hard rumble by their blistering speed.

Transports and bombers are everywhere on the tarmac. During the Oshkosh EAA convention, Wittman Regional becomes the busiest airport in the world.

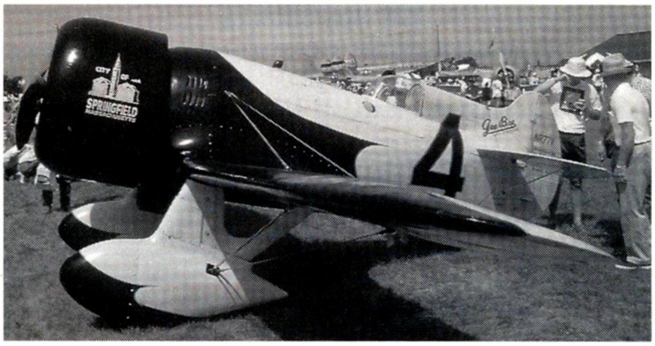
Legendary shapes chased one another through the air-show area as Benny Howard's original Pete chased the Miles Atwood special and a Model E Gee Bee.

None of the shapes was more legendary than Bill Turner's deHavilland Comet. With its long, graceful, elliptical wings and sharp little nacelles covering its Gypsy engines, it was a sight no one at the airport ever expected to actually see.



A rare find at any fly-in is the WW II Hawker Hurricane. Made famous during the Battle of Britain, the Hurricane fought alongside the more popular Supermarine Spitfire.

But then, that's what Oshkosh is always about; making the unexpected happen—like debunking those rumors that they used special effects on the Schwarzenegger movie "True Lies." After watching an AV-8 Harrier hover like a helicopter, the crowd was convinced that the only special effect in that movie was Arnold himself.



The famous Gee Bee Model Z "City of Springfield." This replica is owned by Californian Dave Price.

OTHER OSHKOSH AVENUES

Neighborhoods of note at Oshkosh '95 included the Waco (pronounced Wah-ko). They had the largest turnout ever of the well-known biplanes—from the funky little QDC, which started the cabin Waco line, to the super-svelte SRE speedster, which many consider the epitome of the marquee.

Everywhere you looked, airplanes stretched to the horizon, most with tents under their wings and a path worn in the grass leading from the tent to the showers.

Every afternoon, the airport would be closed for three hours, during which time the crowd was treated to the unexpected—such as watching Patty Wagstaff drag race a jet-powered truck with her Extra 300S (the truck won); and seeing Sean Tucker imitating the Harrier as he hovered down the runway in a slow walk, the hopped-up Lycoming holding his modified Pitts in a stable, vertical position.

Oshkosh lasts a week, is absolutely impossible to see in its entirety and leaves its physical mark on those who try. Those who fail to cover it all come back the next year determined: "This year, we'll do it!" But they'll fail. They will fail because each year the fly-in expands, staying just out of reach of those who want to say they saw it all.

So, if you have a friend who says he saw it all, don't believe him—unless he has developed a severe limp since returning. Then he just might be telling the truth. But, just to be sure, you'd better go with him next year.

Betcha can't see just one!

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

Jet World Masters

The scale jet set competes in Germany

by MIKE CHERRY

World Master Garland 'Ham' Hamilton shows off his immaculately detailed and flown F-80C Shooting Star, built from the BVM kit and powered by a Viojett and BVM 91. Garland's dedication, practice, preparation and consistency paid dividends with nearly perfect flight scores.

DURING THE WEEK OF AUGUST 20 to 27, Schwaighofen airfield, in the city of Neu-Ulm near Stuttgart, Germany, was host to the greatest jet extravaganza ever seen on this planet—the first Jet World Masters (JWM) competition.

Because of increased availability, reliability, performance and reduced noise levels over the past four or five years, the growth of jet modeling gave two fanatical jet enthusiasts (Winfried Ohlgart and me) an idea: "Why don't we start a new scale jet competition class?"

"Yes," said Winfried, "then we can have our own World Championship!" That's how it all began back in April of 1993; and the subsequent formation of the International Jet Model Committee (IJMC) and its recognition by the FAI/CIAM as a special working group took our embryonic concept and incubated it for two and a half years. Finally, it was "hatched" by the DMFV (German Modeling Association) into the first Jet World Masters.

IF YOU BUILD IT, THEY WILL FLY

The Jet World Masters was organized by the DMFV under the guidance of Winfried Ohlgart in conjunction with the model club of Neu-Ulm and with fantastic support from the Neu-Ulm city council, which constructed the asphalt runway especially for this event. The event was a phenomenal success, beyond even our highest expectations. Scale jet models are at the pinnacle of current model aircraft technology, and more than 25,000 spectators came to view these spectacular aircraft during the week, including 15,000 during the final weekend. Given that the weather was not especially favorable, with several heavy rainshowers and thunderstorms, this massive attendance proves yet again that both modelers and the general public want to watch jets.

Markus Aumair of Austria flew his own-design Lockheed YF-22 into 15th place overall. The model was powered by a pair of Gleichauf Maxi pusher fans and O.S. 91 motors, is 91 inches long with a wingspan of 63 inches and weighs about 21 pounds dry. It's now available as a kit from Schleicher Jets in Germany.

Steve Elias' F-80C on short final into the minuscule strip at Neu-Ulm after his almost flawless third-round flight. He earned third place overall and the prestigious Best Flight trophy.

Left: even the Russians competed in the JWM. Valery Gromkow (right) from the Tartarische Republic prepares his Heinkel 162 Salamander for the noise test. It's powered by a Russian Angström 91 motor and fan unit. One evening after a crash, it was completely rebuilt on the airfield with help from the German team.

Swiss pilot Hans Laubsher entered his own design—the Hawker Hunter—and achieved fifth in Static and 13th overall. The model's wingspan is 49 inches, length—67 inches, weighs 15.5 pounds and is powered by a Ramtec fan, O.S. 91 motor and JMP pipe.

Enthusiasts showed up from all over the world, notably from the Orient, Pakistan, the Far East and Japan, making this one of the most internationally attended modeling events ever.

This event was, in effect, a "World Championship," but currently, this new class for scale jets—tentatively named F4J—is only recognized at "provisional" status by the FAI (the world-wide governing body for aviation competition). The event was therefore held as a "World Masters" to test the contest rules and regulations before finalizing or revising them; it will hopefully be granted full World Championship status by the FAI soon.

The contest was held to the provisional F4J rules developed and published by the IJMC and open only to scale, gas and ducted-fan-powered jet models that have been completely built and flown by the owners. Currently, there is no "Team Scale" contest.

WHAT IS F4J ?

F4J consists of three parts, each of which is worth a percentage of the total marks. These are: static judging (40 percent), flying judging (50 percent) and noise test (10 percent). There was an international panel of judges, democratically elected by the IJMC of three persons for the static and five for the flying part, with the highest and lowest flight scores of each flight discarded.

One of the newest models at the WM was Franz Walti's twin JPX T-240 gas-turbine-powered Rafale B01, which placed second in Static and was truly well-constructed and finished, with an astonishingly clever homebuilt undercarriage system. This model is definitely of the 'big' variety, with a length of 88 inches, wingspan of 63 inches and weighing in at about 30 pounds.

The quietest model of the contest and winner of the special trophy was Leif Poulsen's Saab Viggen, powered by a prototype of the new Danish SIM-jet gas-turbine from Taks a/s, which produces about 7.25 pounds of thrust and runs on kerosene. As you can see from this photo, the motor was so quiet that the pilot and crew weren't even sure if it was running!

Wolfgang Klühr, famous for his large twin-engine Mig .29 and Sukhoi SU-27 kits, is seen here with his latest kit version of the Flanker—the SU-30. Powered by a pair of Russian Angström .91 motors, this 102-inch-long model and Thomas Singer's similarly powered SU-27 were unusually noisy and scored very badly in this part of the contest.

Second place overall, Dutchman Hans van Dongen's F-15 Streak Eagle replicates the complex scheme on McDonnell's Time-to-Climb aircraft of 1975. The model, built from the 1/9-scale Philip Avonds kit and powered by a single Ramtec O.S. 91 and BVM pipe, was astonishingly quiet. It earned second highest points because of the hush kit and internal acoustic foam that Hans applied. This 86-inch-long, 15.5-pound model is available in the U.S. from Aeroloft Designs.

Left: Thomas Singer's twin-engine Sukhoi SU-27, built from the Modellbau Klühr kit, sends up a stream of spray as it careens through a puddle on the runway. This model is 102 inches long, 69-inch wingspan and weighs only 26 pounds, and every one I have seen flies exceptionally well.

Each competitor made three flights, discarded his lowest score, and the final points were the average of the other two scores. Apart from the mandatory takeoff, straight-and-level pass and landing, each competitor attempts five other maneuvers chosen from aerobatic, non-aerobatic and technical options, which include a proviso for one "special" flight maneuver.

Static judging required full documentation and took into account scale accuracy (3-views), color, markings, surface texture and realism, craftsmanship and scale detail; all models were judged for exactly 15 minutes.

The noise test part of the contest required that each competitor's model be run at full power on a specially made elevated stand, so that noise measurements could be taken from about 8 yards away. The highest and lowest readings set the endpoints of a straight line on a graph, and points ranged from zero for the loudest model, to 300 for the quietest and pro rata in between. Finally, no bonuses (or "K" factors) were awarded for special considerations, such as own-design, scratch-built models or multi engines. If you want a copy of the complete F4J rule book, contact your country's IJMC member, or send an SASE and $10 US to Art Arro at the Jet Pilot's Organization*.

Burkhard Dotzauer of Leipzig in old east Germany placed 14th overall with his own-design Aero L39 Albatross, but unfortunately, lost his model because of radio problems. Powered by the ubiquitous O.S. 91 mated to an old Gleichauf Maxi pusher fan, this 71-inch-long model was quiet and performed well, helped by its light weight at only 12.5 pounds.

THE SITE

The Schwaighofen airfield was a superb site for this event because it had all the necessary infrastructure, including hangars for model storage and static displays, canteens and bars and a huge area for camping and parking. The runway was less than ideal—a tarmac strip of only 102 yards long and 8 yards wide with short grass runoffs at both ends, but after all, this was a "World Masters," and I suppose the competitors should be qualified enough to operate from this, shouldn't they?!

The DMFV had been almost forced to use this site, because the chosen full-size airfield became unavailable at the last minute, but a gargantuan effort by the DMFV and the Neu-Ulm model club made it happen and, under the circumstances, it was extremely well-prepared and organized. There were a few models that didn't make it off the strip because of their length, or because they were damaged during takeoff or landing, but to be fair, the strong and variable direction of the prevailing gusty crosswinds didn't help matters.

All the spectators were totally spellbound by the capability and reliability of the jet models, which were heavily laden with scale detailing and relatively quiet. Many of the propeller-powered demonstration aircraft in the Sunday airshow were much noisier!

Twenty one countries registered for the JWM, but several dropped out at the last minute, or didn't make any successful competition flights. Fifteen actually competed, including Germany, U.S.A., Canada, Great Britain, Austria, Italy, Finland, Norway, Denmark, Scotland, Switzerland, Holland, France, Belgium and the Tatarische Republic (Russia). Unfortunately, Japan was excluded from the airfield because their huge, twin, gas-turbine-powered Boeing 747 Jumbo was two pounds over the maximum weight limit.

THE ACTION

The new World Master, Garland 'Ham' Hamilton, chose a bomb drop as his special maneuver and hit the target on the judge's center line with 100 percent accuracy every time, impressing the judges as much with this as with his nearly flawless maneuvers and the superb flight realism of his Bob Violett Models* (BVM) F-80 Shooting Star.

Dutch pilot Hans van Dongen took second place overall and proved that to do well in a contest such as this, you really need to know your model. Hans had practised intensely for this event, putting in more than 100 flights to learn all the quirks and nuances of his Avond* F-15 Eagle. He consistently put in extraordinary flight

FINAL POSITIONS

Pos./Pilot	Country	Model	Kit or O/D	Motor & fan	Noise points	Static points	Flying points	Total score
1 Garland Hamilton	USA	F-80 Shooting Star	BVM	BVM91/Viojett	175.86	1093.60	1044.38	**2313.84**
2 Hans van Dongen	Holland	F15 Streak Eagle	P.Avonds	OS91/Ramtec	237.93	998.80	1034.38	**2271.11**
3 Steve Elias	Great Britain	F-80 Shooting Star	BVM	BVM91/Viojett	113.79	984.20	1137.50	**2235.49**
4 Reto Senn	Switzerland	Rafale CO1	Aviation Design	PX T240	113.79	1120.20	936.88	**2170.87**
5 David Ribbe	USA	F-16 Falcon	BVM	BVM91/Viojett	51.72	1061.20	1038.75	**2151.67**
6 Jerry Caudle	USA	P-80 Shooting Star	BVM	BVM91/Viojett	113.79	1143.00	881.25	**2138.04**
7 Martin Lefevbre	Canada	CF-18 Hornet	Yellow Aircraft	OS91/Dynamax	113.79	943.20	1038.75	**2095.74**
8 Mike Cherry	Great Britain	F15-C MSIP Eagle	P.Avonds	OS91/Ramtec	165.52	1014.00	905.63	**2085.15**
9 Peter Cmyral	Austria	RFB600 Fantrainer	O/D	OS108/O-D	93.10	971.00	1007.50	**2071.60**
10 Roger Shipley	USA	T-33 Canadair	BVM	BVM91/Viojett	62.07	1063.20	937.50	**2062.77**

Special Awards

Highest Static—Jerry Caudle (BVM P-80B Shooting Star)

Highest Flight Score—Steve Elias (BVM F-80C Shooting Star)

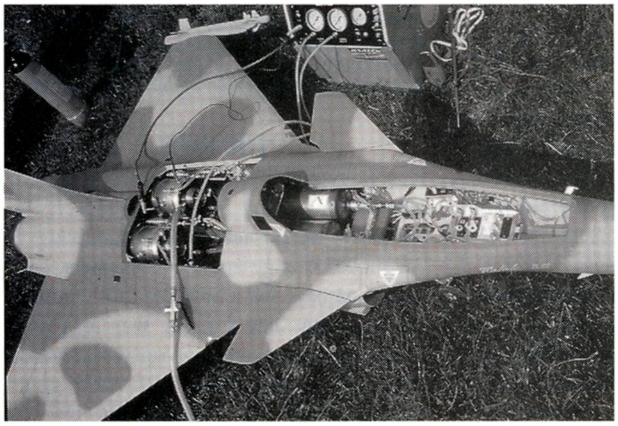
Quietest Model—Leif Poulsen (Saab Viggen/Sim-Jet turbine)

Nations Trophy

1st	USA	(G.Hamilton, D.Ribbe, J.Caudle)	6603.55 points
2nd	Switzerland	(R.Senn, H.Laubscher, P.Rutimann)	6103.11 points
3rd	Holland	(H.v. Dongen, M.Caris, J.Kuipers)	6066.55 points
4th	Germany	(R.Sedlemeier, B.Dotzauer, T.Singer)	6029.10 points
5th	Great Britain	(S.Elias, M.Cherry, I.Richardson)	5946.95 points

scores (even in poor conditions) and, believe me, the F-15 is not easy to fly accurately in gusty crosswinds.

Steve Elias demonstrated his immaculate control with his F-80 Shooting Star and achieved third place overall. He had only finished applying the decals and markings to his plane the night before static judging, and he had only made one very short test flight before the contest. He showed his true skill by achieving increasingly higher flight scores in every round and deservedly winning the "Best Pilot" trophy. His years of Pattern flying experience were evident.



A look inside Franz Walti's twin JPX T-240 gas-turbine-powered Rafale B01 shows how well-constructed the model was.

To stand a chance of becoming the World Master, or even just to finish in the top 10 places, you needed good scale documentation, a relatively quiet model, total confidence in your model and plenty of competitive practice with it under all weather conditions. Many excellent pilots fell by the wayside because of poor scores, or because of unreliable models and propulsion systems.

Perhaps the biggest surprise of the WM was how poorly the German team fared in the overall results because of very low noise points and possibly, insufficient scale documentation (even though the flying points scored by almost every member of the team were consistently in the top 10). This contest is *not* just about flying, and you can be sure that these and several other top pilots will have learned from this event and will be much harder to beat the next time. Because of the current noise test, the twin-engine aircraft were at a definite disadvantage this time, but it seems likely that the bias on this will be changed for the next WM in 1997.

Most gas-turbine-powered models also fared badly in the noise test, even though they are extremely quiet and realistic in the air. This is another subject that the IJMC will be addressing. There was only one gas-turbine model in the top 25 places—Reto Senn's marvelous JPX*-powered Rafale, which finished in an outstanding fourth place overall. But you can be certain there will be more next time.

Scale jets from the Bob Violett Models (BVM) range were once again favored by many of the top competitors; at least five BVM models finished in the top 10 places. Many of the "easy to fly" Philip Avond F-15s also fared well, even in the hands of relatively inexperienced pilots. Second place by an Aviation Design* Rafale and seventh place by one of Yellow Aircraft's* new single-engine Hornets showed just what can be achieved.

CONCLUSION

This first Jet World Masters was a sharing of ideas that benefits jet modelers from all countries—existing enthusiasts *and* newcomers to the sport. The latest technology in this demanding section of R/C aviation will also filter down to other sections. The superb finishing and detailing techniques used by the Americans, the simplicity and "flyability" of some of the European models and the spirit and organization of the Swiss team were all noteworthy. To me, the camaraderie between competitors from different countries was most pleasing, with even the top pilots helping each other out and repairing models when necessary. If only all sports were like this! (On a personal note, I want to thank both the German and Swiss teams for helping to repair the undercarriage on my F-15, enabling me to complete the contest.) Most countries showed a great deal of professionalism and had worked hard to elicit sponsors who helped turn out well-presented teams, with matching jackets and shirts, etc.

One thing is certain: it will be far more difficult to win, or even finish in the top 10 places in the next WM in 1997. It will probably be held on a full-size airfield in Great Britain, and I look forward to meeting you all there for some hot competition. It's not too early to start working toward that event now.

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

FIELD & BENCH REVIEW

A factory-built, Wolfgang Matt-designed pattern ship

THE PICA/ROBBE Rubin—designed by Wolfgang Matt—is a big model that comes in a box that's longer than I am tall. Inside are some of the best pre-built parts I've ever seen. The fuselage is factory-built, the wings and tail come sheeted and, along with their respective control surfaces, are placed back into their foam-core shucks for shipment. The fiberglass belly pan, the canopy and the wheel-well inserts are in separate plastic bags. Everything in this kit is of high quality.*

Pica/Robbe Rubin

by RICK HELMKE

The author takes a moment to pose with his Pica/Robbe Rubin pattern bird.

FUSELAGE AND WING

If you've built a few models, the Rubin is uncomplicated, but for a rookie, the instructions won't help much. They're written in several languages, and there's one set of numbered, technical drawings that are referred to regularly, but I couldn't quite figure out how to install the wing fillets, or which materials I should use to make them. Also, installing the tail-wheel bracket is somewhat confusing. I substituted a less complicated Du-Bro* unit on my plane.

The wing halves are well-made, standard, balsa-covered foam-cores. Joining them is straightforward. The roots are precut to the correct dihedral angle so, with even minimal care, a straight wing is easy to accomplish. I found two problems during initial flights. Because the wing-core isn't as dense as those made in the U.S., on the fifth landing, both landing gear pulled out. You should make the gear-support boxes bigger than the plans call for. The other problem is in the rear-wing hold-down plate. This ¼-inch plywood piece is installed at the factory, and when I removed the wing after the fifth flight, the glue joints were broken and the part was nearly ready to come out. I re-glued it, added triangle bracing to the bottom, drilled holes in both sides and installed pegs for reinforcement. I've noticed this problem on other Rubins, so be sure to do this while you're building.

PHOTOS BY RICK HELMKE & GLENN BAESKE

ASSEMBLY

The wing is mounted on the fuselage with two dowels in the front and two bolts threaded into hardwood mounts in the back. Once the wing has been set in place and is straight, attach the tail surfaces. Cutouts in the fuse for the horizontal stab and vertical fin are already done, and only minimal sanding is required before the tail parts can be glued into place. I used Tite-Bond to allow more time to line everything up. This should be done on a flat surface with the wing attached, and measure the model's alignment every way you can think of. When you're sure it's all straight, leave it alone for several hours to dry.

Retract installation is straightforward. Wheel wells are precut, but the builder must make the gear cutouts and box structures for the gear mounts. I built a wooden box for the gear mechanisms. I've done the same with other models, and the extra weight has always paid off in fewer repairs.

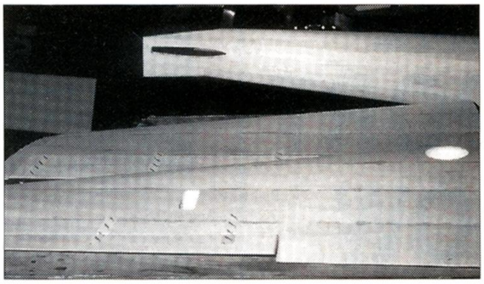
Mounting the belly pan was the only hard part of building this model. It's the only fiberglass part in the kit, and it's very light. It doesn't fit very well, so be patient while you install it. The two formers that are glued into the belly pan don't leave much space for an exhaust system, so you will have to do some grinding. For strength, add some carbon-fiber matte to the attachment points.

ENGINE AND RADIO

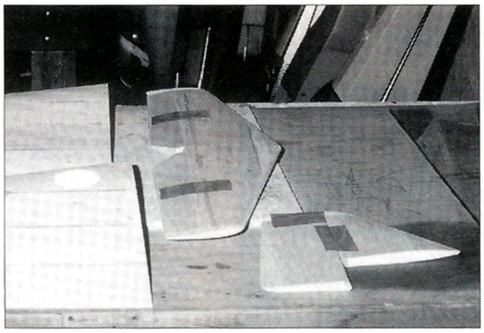
Engine-thrust offset is already built into the beam mounts, so if you align your spinner's backplate with the nose ring, you won't need to do anything else. An isolation mount of some type is needed to align the engine correctly from top to bottom, and I found the Sullivan* engine mount (no. 285) to be perfect. I installed an O.S.* 1.20 supercharged engine; it's big, and the fit is tight.

The instructions show a single pushrod from the radio compartment to the elevator. I modified my setup so that it used separate elevator servos mounted near the tail. Make sure both pushrods are parallel, and position your servos accordingly. I used Futaba* 9101 servos because they're more consistent, work better for precision flying and last longer than the standard

S-148 servos. A Y-harness at the servo end allows you to use only one long servo extension. The rudder servo is mounted forward in the fuselage and uses a standard pull/pull arrangement. Aileron servos are mounted in precut holes in both wing panels; they're toward the middle of the panels but close enough to the center line so that a standard aileron extension lead is all that's required. I built hard points into all the control surfaces where I intended to put control arms.



The wings as they come out of the box—nicely planked with balsa.



Even the tail parts are complete and ready to attach.

A Futaba 136G servo pulls up the wheels, and an S-148 controls the engine. Guidance comes from a Futaba Super Seven PCM.

FINISHING

Finishing is a matter of choice. The structure is so light that you can use paint, glass, or iron-on finishes. The Rubin is built out of extremely light wood, which means it's quite soft. I had to repair several small dings during construction. I used .5-ounce glass cloth and Pacer* Z-Poxy finishing resin, which I topped with K&B* paint. I replaced the supplied stick-on decals with a sharp graphics package from Patterns Plus*. The finished weight is $9\frac{3}{4}$ pounds.

The engine you choose depends on how you balance the aircraft. In the instructions, the CG is listed as a metric measurement, and I thought it was

SPECIFICATIONS

Model name: Rubin

Type: low-wing ARC pattern ship

Manufacturer: Pica/Robbe

List price: $380

Wingspan: 72 in.

Wing area: 936 sq. in.

Weight: 9.5 lb.

Wing loading: 23.38 oz./sq. ft.

Length: 72 in.

Engine used: O.S. 1.20 supercharged 4-stroke

No. of channels req'd: 5 (aileron, elevator, rudder, throttle, retracts)

Features: the Rubin comes with a factory-built, balsa-and-foam fuselage, tail and wing. It has a fiberglass belly pan, a clear canopy, a decal sheet and basic hardware.

Hits
- Excellent factory construction.
- Light and straight alignment.
- Good flight characteristics.
- Excellent value.

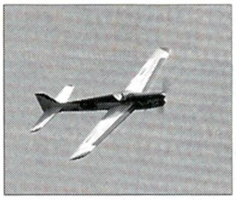
Misses
- Poor instructions.
- Weak factory-installed wing hold-down plate.
- Belly pan wasn't of the same high quality as the rest of the kit.
- Wing foam-core is not as dense as U.S. designs.

FLIGHT PERFORMANCE

After I had tinkered with the usual little things, I decided the plane was ready to go. Contest season was right around the corner, and I needed to get cracking with the Masters pattern. The first flight was one of the most memorable I've ever had because of what didn't happen. The model took off and went perfectly straight. The trims were centered, and they never changed. I've been flying models since I was four years old, and that has never happened to me.

• Takeoff and landing

With an O.S. 1.20 SP pulling the $9\frac{1}{2}$-pound Rubin, takeoffs are noticeably short for such a large model. Seventy-five feet on grass and about 50 feet on pavement are normal, and then the Rubin is ready to pull straight up into vertical for as long as you want it to. Landings are different than with most pattern ships because the Rubin's nose should be kept low before touch down. If you want them to, many pattern models can drag their tail wheel long before the mains touch down, but if you try that with the Rubin, it may stall.



• Low-speed performance

The Rubin is rock-steady all the way up to the stall. Ailerons maintain authority, and the wings don't wobble at all up to the break.

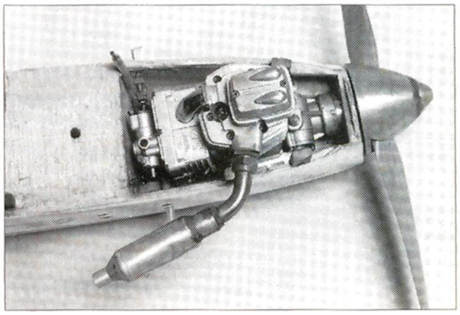
• High-speed performance

The Rubin is faster than most American-designed pattern planes. To take advantage of its speed characteristics, you need to fly it "out and big," and it does well in windy conditions.

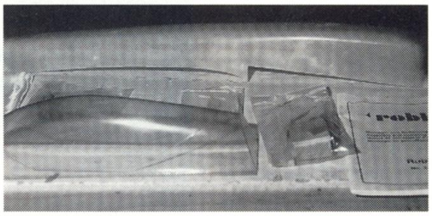
• Aerobatics

Naturally, this is the forte of the Rubin. As a competition aircraft, there is nothing it does poorly. Because of the low deck angle, spin entries take a bit of getting used to, but everything is normal and maneuvers are executed well. There is little tendency toward adverse yaw, but only because of the aileron differential. Without differential, adverse yaw can be a problem; but this is the case with most competition models.

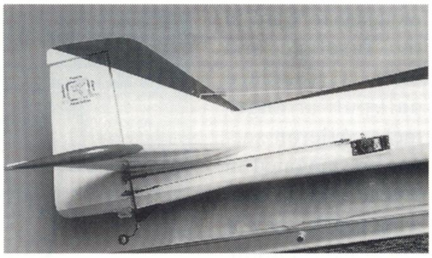
Inverted flight is a cinch, with only slight forward pressure needed on the elevator. Rolls are quick; they begin with authority and end crisply. The roll rate stays high even at low speeds. Vertical lines go on forever, and tall looping maneuvers are done with ease. The hourglass and vertical-8 maneuvers found in the FAI pattern are done smoothly and without strain. Corners are smooth and tight, even at high speeds. Spins are tight and a bit sloppy on recovery unless you input opposite controls.



The O.S. 1.20 supercharged engine is the largest pattern engine allowed in Pattern competition. It fits in the nose of the Rubin, but it's tight.



The formed parts of the Rubin kit include the canopy and the belly pan. Installing the pan was the hardest part of the project.



I used dual-elevator servos at the rear of the model to eliminate the need for long pushrods and to add some redundancy in case of servo failure. This type of installation must be thought out carefully before you start to cut!

too far forward. Start at least 1 inch back from where the instructions indicate. As with all pattern ships, the CG should be placed where it is most comfortable for the pilot.

I've seen this model powered by the Saito* .91. The vertical is not quite as good, but it works well in Sportsman and Novice classes. I suspect that all the YS* 4-stroke offerings would do very well in this model.

The Rubin returns from another round of Masters competition. Many pattern fliers land dead-stick on purpose; it protects those expensive propellers!

The attractive, European-looking Rubin is quite different from American designs. It has a long nose with an aft-positioned canopy that takes some getting used to compared with the Desire and Jekyll designs. So far, flying the Rubin has been a pure pleasure. I haven't found any bad habits, and at around $380, it's one of the best buys on the market today.

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

FIELD & BENCH REVIEW

TOP FLITE GOLD EDITION P-51

This next-generation Mustang is a true thoroughbred

by CLIFF BECKER

THE P-51 MUSTANG is one of the most famous military warbirds. Built by the North American Aircraft Co., the prototype Mustang (NA-73X) first flew on Oct-ober 26, 1940, at Mines Field, CA. It was piloted by noted freelance test pilot Vance Breese. The flight took place only 120 days after the project had begun! The Mustang was the first aircraft to have a laminar airfoil included in its design, and it was powered by the Allison V-1710 12-cylinder engine.

On July 7, 1941, before the XP-51 had been completely tested, the USAAF placed an order for 150 aircraft for the RAF, 93 of which were delivered. It wasn't until October 13, 1942, that the first Mustang powered by the Rolls-Royce Merlin engine took flight. It was this airframe/engine combination that made the Mustang a true thoroughbred.

NEW-GENERATION MUSTANG

Compared with the old Top Flite* Warbird kits, the new Top Flite Gold Edition kits (including the AT-6 Texan, the P-40 Warhawk and the F-4U Corsair) are a great improvement. Their instruction manuals make these kits "builder friendly." Simplified, computer-designed parts make it possible to build the kits very quickly and precisely. The plans are clear, and many options are included, so you can build the models to your liking.

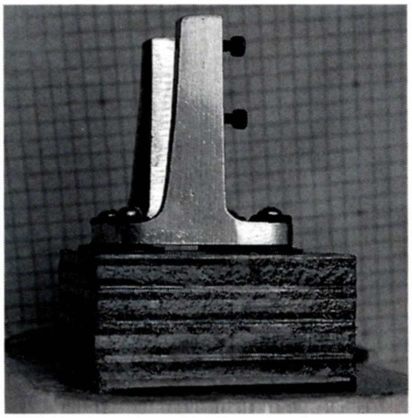
Before you begin construction, decide which features you'll incorporate (flaps or retracts, a 2-stroke or 4-stroke engine). A friend of mine built his kit entirely according to the manufacturer's directions and installed a Saito* 120. His plane's final weight was $9^3/_4$ pounds. I spoke with another builder at the WRAM show, and his plane weighed $8^3/_4$ pounds; he, too, had precisely followed the manufacturer's instructions. So I decided to build mine with flaps, retracts and drop tanks. I used a SuperTigre* .90 2-stroke for power. The plans and instructions for the kit are concise and clear, and I can't make any suggestions that would improve on what needs to be done to build the model. What follows is an overview of my kit.

CONSTRUCTION

I began by building the vertical stab, which is built of balsa and sheeted with 1⁄16-inch-thick balsa and has a solid balsa tip. The airfoil-shaped tail surfaces are fairly easy to build. The rudder is also made of built-up balsa; it has exposed ribs, and it looks great when it has been covered with 21st Century* fabric covering. After I had completed the tail section, I was ready to get on with the rest of the construction.

After I had studied the plans and instruction manual and looked over the die-cut parts, I decided to build the wing on a magnetic building board. After popping out the ribs—all the building tabs are rigidly attached to each rib—I positioned them over the plans. The instruction manual shows both fixed landing gear and retract options. I chose Rhom-Air* retracts with 3⁄16-inch wire struts. To dress the retracts up a bit, I installed Robart* scale strut fittings and used Robart WW II-style wheels. I reinforced the landing-gear area in the wing with fiberglass cloth and epoxy. Owing to the interlocking design of the wing parts, the wing builds up very quickly. The wingtips include plywood inserts to protect them from hangar rash—a nice touch.

PHOTOS BY CLIFF BECKER



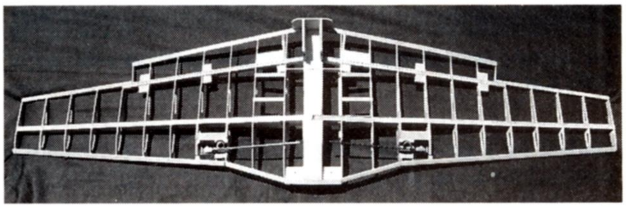
To keep noise levels down, I soft-mounted the SuperTigre. Notice the plywood stack used to correctly position the mount.

FUSELAGE

The fuselage construction is easy, and it can be assembled quickly with interlocking parts. The plywood pieces form a tightly fitting box structure, to which everything else is attached. The tail-wheel assembly is totally encased in the aft fuselage, and the many photos and three pages of instructions make it easy to assemble. The manual provides precise directions for installing either a 4-stroke or a 2-stroke engine, and a gauge is included so that the firewall can be installed at the proper angle and position. The instructions offer different ways to construct the wing fillets. The final fuselage assembly needs very little sanding to establish a surface that's ready to finish.

FINISHING

I sanded the entire plane smooth with 220-grit sandpaper and applied lightweight fiberglass cloth using Satellite City* Hot Stuff UFO thin CA. I first cleaned all the dust off the wing and fuselage, and then I ran a tack cloth over all the parts that were to be covered. I sprayed the surfaces of the model with a very thin mist coat of 3M spray 77 adhesive. I cut the cloth to size and draped it over the model one section at a time, and then I saturated it with thin Hot Stuff UFO. The CA wicks into the cloth's weave and bonds it to the model's balsa surface. To feather in the cloth edges, I sanded them where they weren't attached to the structure. This process yields a smooth, lightweight finish that's ready for primer.



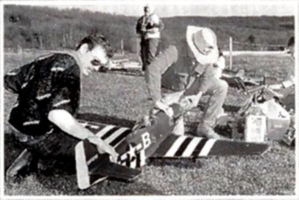
The wing all framed up with the Rhom-Air retracts in position. The parts fit very well throughout the kit.

FLIGHT PERFORMANCE

• Takeoff and landing

After a few taxi runs up and down the field to get a feel for ground handling—and to get photos—I refueled the model and ran out of excuses.

I smoothly added full throttle, and the Mustang rolled down the field. With the SuperTigre .90 up front turning a 13x6 prop, a lot of right rudder was needed to track straight. The model easily lifted off within 60 feet and climbed out effortlessly. The only trim required for the first flight was some right rudder and a little down-elevator. The P-51 flew straight and level nicely hands off.



Don't forget to drop the flaps on the downwind leg. On my first landing approach, I forgot to deploy them. The bird was coming in too fast, so I decided to go around for another approach. Just as I increased power, the grass field grabbed the retracts before the plane had gained altitude. The Mustang slid about 100 feet before it stopped. The only damage was to the retract mounting rails. All the plastic parts held up well. Within two hours, it was back in the air and flying like a real winner.

Landing with flaps makes all the difference in the world. When the flaps have been lowered, there's a nose-up trim change that you should re-trim to correct. Most computer radios will allow flap/elevator trim mixing, and this minimizes retrimming corrections and gives you more consistent landings. Keep the nose down, and maintain adequate air speed. On final, add a little nose-up trim for the flare, and bring it over the numbers with a little power. Rollout is straightforward for a tail-dragger; just keep on the rudder until the model has settled down.

• High-speed performance

The P-51 is very smooth at high speeds (as a fighter should be). Pitch and roll control are solid, and the model should be set to the travel values suggested in the manual. As speed increases, the model requires some down-trim (three or four clicks) for straight and level flight.

• Slow-speed performance

The Mustang has good control at reduced speeds, all the way to stall. As the nose of the model is raised to slow its speed, you should use more rudder control and less aileron. This will protect the wing from any unexpected tip-stall, especially on landings. With the gear down and the flaps extended, there's a lot of drag, so you need to keep the angle of attack low and keep in some power.

• Aerobatics

The Mustang was put through its paces starting with a roll. Roll rate is very good, and the model easily stayed parallel with the horizon. Loops are smooth and majestic and require almost no rudder for heading correction. Maneuvers such as the split-S are also smooth and predictable, and they're a great way to get the model down in a hurry. A low, high-speed pass pulled up into a victory roll is a great-looking finale for any flying day. Just remember to lower your landing gear and to use flaps when you land.

SPECIFICATIONS

Model name: P-51 Mustang (D version)

Type: 1/7-scale WW II fighter

Manufacturer: Top Flite

List price: $249.99

Wingspan: 65 in.

Airfoil: semisymmetrical

Weight: 9½ lb.

Wing area: 734 sq. in.

Wing loading: 29.86 oz./sq. ft.

Radio req'd.: 4 to 6 channels (throttle, rudder, aileron, flaps, retracts)

Radio used: JR 388S

Engine req'd: .60 to .90 2-stroke, or .90 to .1.20 4-stroke

Engine used: SuperTigre .90 2-stroke

Features: the Top Flite P-51 has all-balsa and plywood construction with tab-lock construction for accurate alignment and easy building. The plans include retract and flap construction details and the details for 2- and 4-stroke engine installation. The kit also includes an excellent, photo-illustrated instruction manual, hardware, decals, formed plastic cowl and canopy.

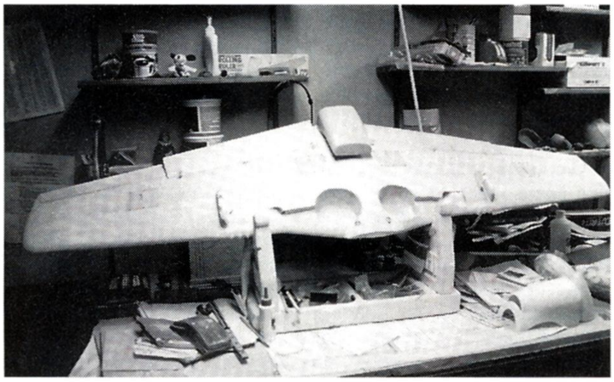
Hits

- Excellent instructions and plans.
- Relatively easy construction for a scale model.
- Strong, lightweight construction.
- Good flight performance.

Misses

- None

After the fiberglass cloth had been applied, I lightly sanded the model and primed it with K&B* two-part primer. After another primer coat and more sanding, I sprayed on the final, custom-mixed, flat K&B colors. This process increased the plane's weight by only 13 ounces—not too bad for a spray-paint job. The plastic cowl and air scoop presented no difficulty and saved considerable work. To finish off the model, I used Dry-Set* decals, which looked as though they had been hand-painted or air-brushed onto the model. If you use them, be sure to apply them at or above room temperature.



The underside of the primed wing. Notice the wheel wells, the drop-tank mounts and the servo covers for the flap and aileron servos.

The Mustang fuselage has been covered with fiberglass cloth and is ready to prime.

DROP-TANK CONSTRUCTION

For a little something extra, I added functional, scale drop tanks to my model. I made them out of Styrofoam, cut them to shape, sanded them to their final size and covered them with fiberglass cloth that I applied with UFO. I then primed them and spray painted them with K&B paint.

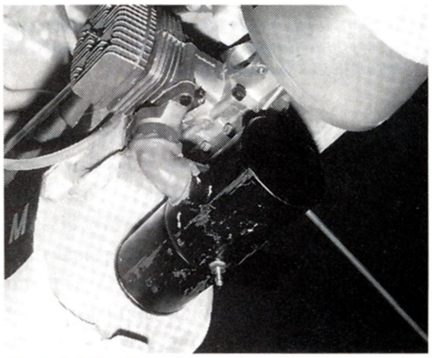
AT THE FIELD

As I pulled my new P-51 out of my truck at our field, like most warbirds, it drew a lot of attention. Everyone was impressed with the finished product. I carefully went through my checklist and made sure that all the wires had been properly connected. I used my JR* 388S radio and standard servos throughout. After checking all the servo throws, I secured the wing into place, pumped up the Rhom-Air retracts and tested their operation. The SuperTigre .90 started right up. Our sound marshal was impressed with the low dB level, which was a result of the Davis Model Products* Pitts-style muffler that I had installed. As the engine rpm rose, so did my adrenaline. A final check of all the throws and retract air pressure, and it was time to taxi onto the field.

SUMMARY

Top Flite has developed an instruction manual that makes the kit very enjoyable to assemble. It includes all the information on how to successfully complete a scale plane.

For a lightweight finish, I covered the model with fiberglass cloth applied with thin UFO. This is an easy way to finish any fully sheeted model.



To quiet the SuperTigre, I used a Davis Model Products Pitts-style muffler; it fits nicely within the cowl for improved scale appearance.

No secrets are withheld on how to build a winner. If you're an average flier, you should build a "plain vanilla" P-51 first without all the bells and whistles; that way, you'll be able to build it as light as possible. After you have flown it and learned how it performs, then build your scale masterpiece. I highly recommend this kit.

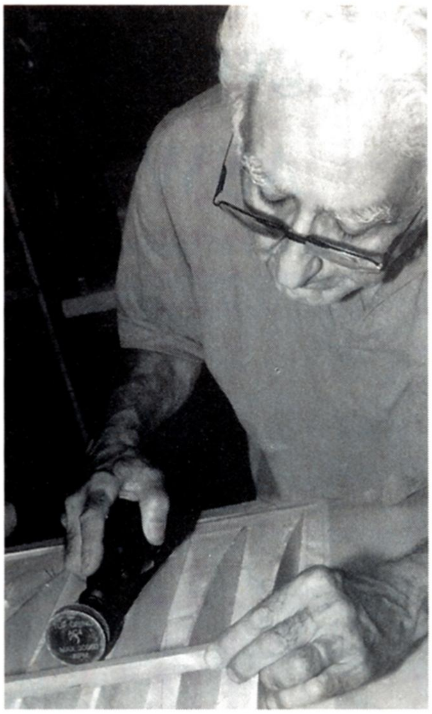
**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

HOW TO

A simple tool for a difficult task

Cutting Notches Made Easy

by JOE BESHAR

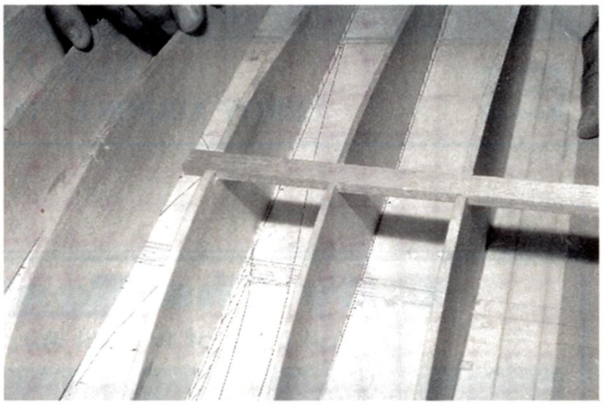


Here, Joe Beshar cuts notches in his wing ribs quickly and precisely using his notch-cutting tool and a spacer block.

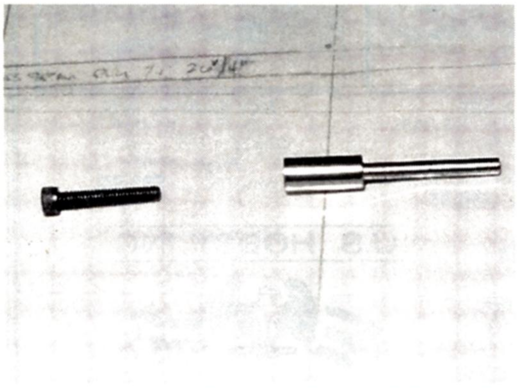
THERE'S NOTHING QUITE as satisfying as building straight and true models. But cutting and aligning notches in ribs and formers has always been a challenge for scratch-builders. Properly aligned stringers and spars are key ingredients to a properly assembled model; the bigger the model and the respective stringers and spars, the more difficult it is to align them. Large stringer and spar stock is not very flexible, and forcing the pieces into place can break them or cause the model's structure to warp. When constructing the wing, this is very critical because any warp or twist significantly affects the model's flight characteristics. Here's how I create perfectly cut and aligned notches.

CUT AS YOU GO

Instead of cutting all the notches first and then trying to align all the parts perfectly, try cutting the notches after the parts have been assembled over the plans. For wings, pin the ribs into place and then use a straightedge to mark the spar's location on top of each rib. Then cut the notches, and fit the spars into place. When you build a fuselage with notched formers that accept stringers (such as that on a Gee Bee racer or a Stearman biplane), glue the formers into place on the fuselage sub-structure, and then mark the stringer locations with a flexible straightedge or yardstick. Mark a couple of notches on one side, then cut them out and install the stringers; then mark, cut and install a couple on the other side. This will prevent the stringers from bowing the fuselage out of alignment, and it will keep each stringer straight and aligned with the one next to it. But how do you cut nice, square notches consistently?—



Properly sized notches for spars and stringers are key to well-assembled models. It's always a challenge to cut them quickly and precisely.



A simple tool for a difficult task: this mandrel holds two cutting wheels and a wooden spacer. Made of steel, the mandrel is drilled and tapped for a 5-40 cap-head screw.

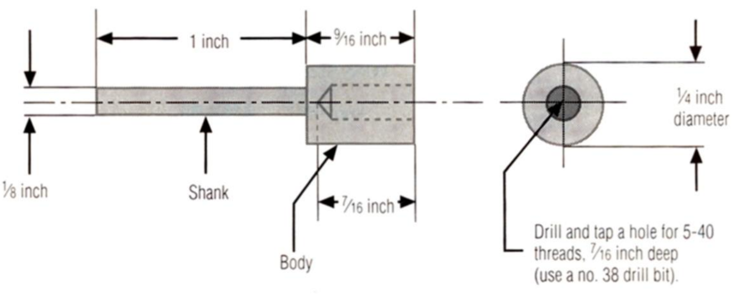


Figure 1. Notching tool mandrel.

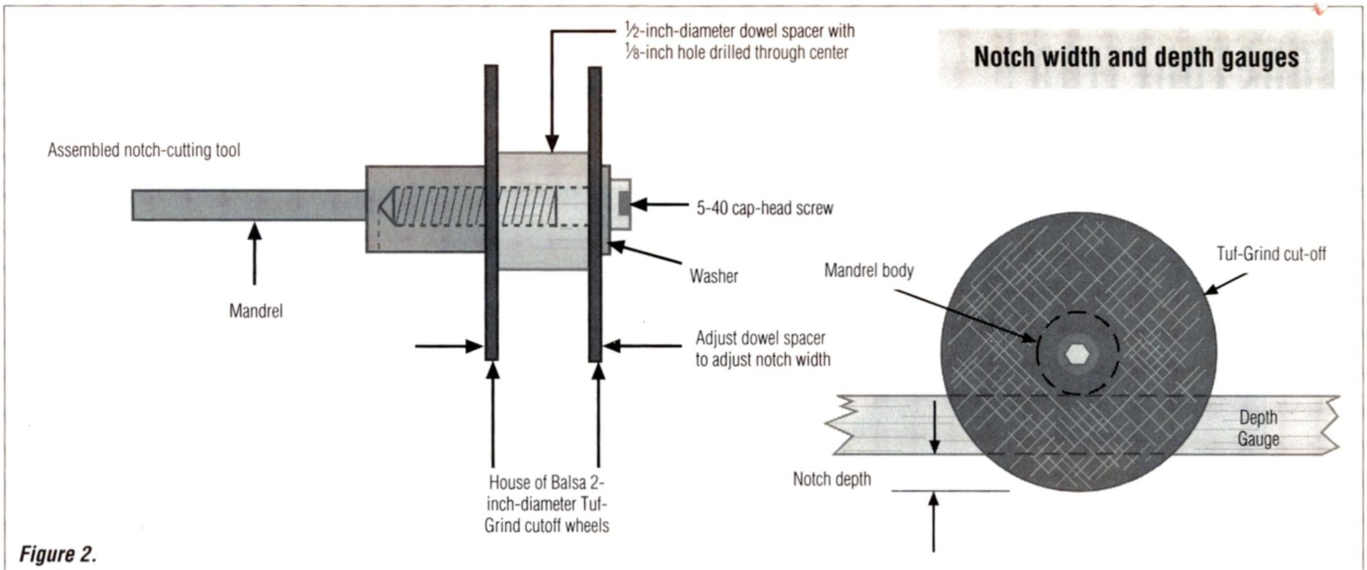
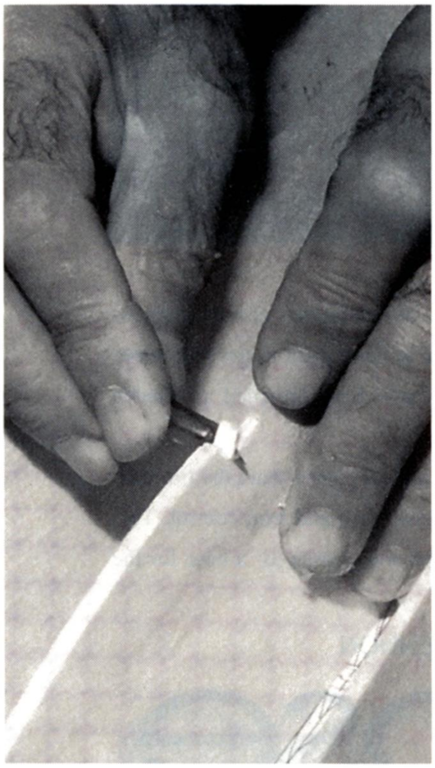
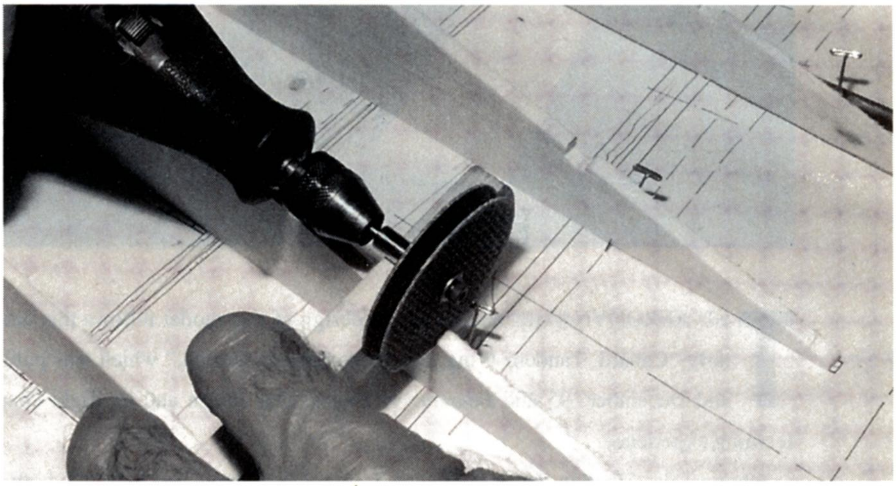


Figure 2.



The scrap material is simply cut away with a sharp hobby knife.

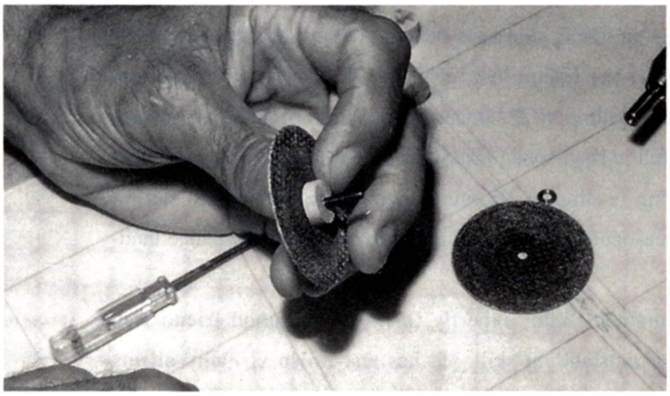


The tool is chucked in a Dremel Moto-Tool and placed over the part to be notched. The notch depth is regulated by the height of a spacer block.

with an easy-to-make tool and depth gauge.

THE TOOL

My notching tool is nothing more than a steel mandrel that is similar to the standard mandrel that comes with most Dremel* Moto-Tools (see Figure 1). It has a 1x⅛-inch-diameter shank and a ¼-inch-diameter body that's drilled and tapped for a 5-40 cap-head screw. I use this mandrel to hold two House of Balsa* 2-inch-diameter, Tuf-Grind cut-off wheels, which I separate with a wood spacer for the desired notch width. The depth of the notch is controlled with a simple hardwood spacer block that rests on top of the model and is of a size that will give me notches of the proper depth (see Figure 2).



A ½-inch-diameter dowel with an ⅛-inch hole drilled through its center separates the two Tuf-Grind cut-off wheels. Vary the width of the spacers to cut notches of different widths.

CUTTING NOTCHES

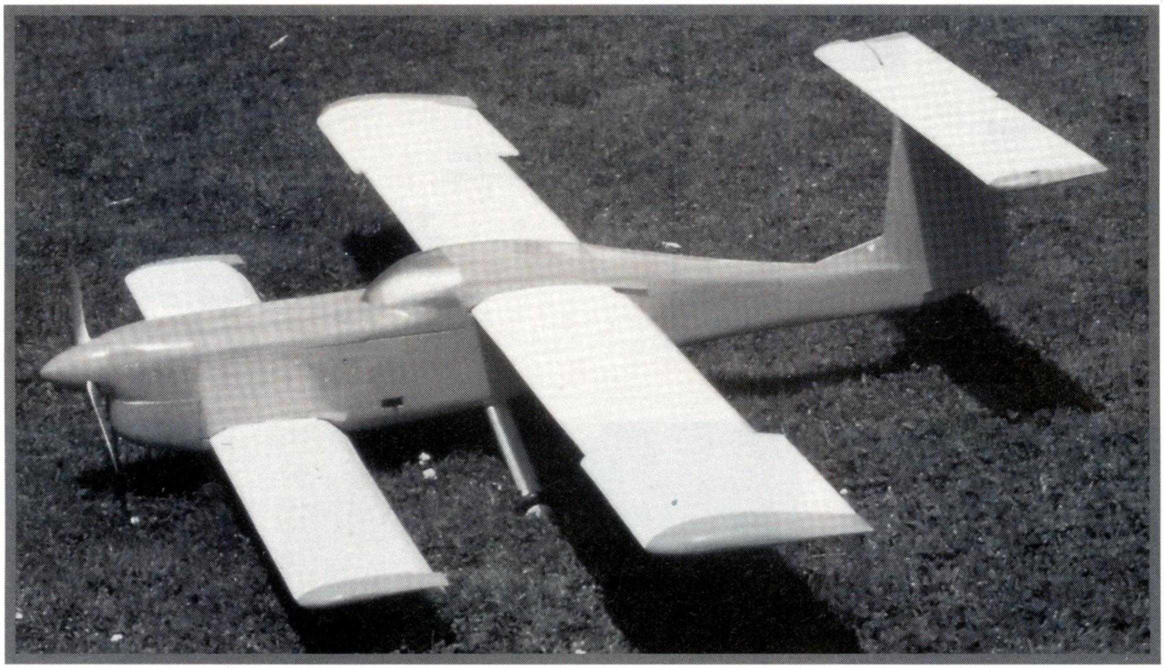
The mandrel is chucked into a Moto-Tool, and the cut-off wheels and spacer are attached to the mandrel with a 5-40 cap-head screw. I then lay the wooden spacer block on the structure and, using the marks drawn on the rib or the former, I feed the cutting wheels into the part. When the body of the mandrel comes into contact with the spacer block, I know the cut is complete.

This leaves two thin slots in the part, and the scrap material between the slots is simply cut away with a sharp hobby knife. This system works very well and, by adjusting the height of the spacer block and the dimensions of the wooden spacer between the two cut-off wheels, you can make notches of any size quickly and precisely. Give it a try.

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

CONSTRUCTION

A stable, three-surface design



PHOTOS BY ANDY LENNON

THE AERODYNAMIC and structural design of this model follows this author's design articles closely, particularly "Canard, Tandem Wing and Three-Surface Design," which was published in three parts in the November and December '95 and January '96 issues. The design and its flight characteristics have provided a valuable learning experience.

Option 1 described in Part 3 of the article mentioned above was selected; both fore and aft planes share the lift load; the horizontal tail provides no lift up or down at cruise speed, but its elevators exercise pitch and trim control. This permits the use of slotted flaps on both fore and aft planes. A cruising speed of 60mph was chosen as a base for the angles of attack of all three surfaces for level flight.

by ANDY LENNON

Wild Goose

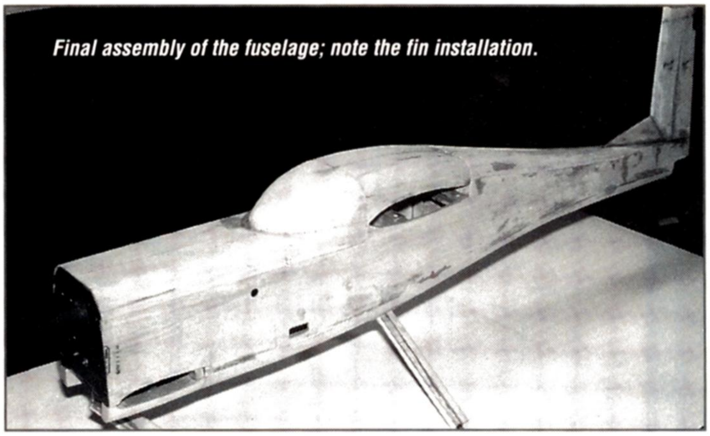
The foreplane must provide lift to support its share of the model's weight, but it must also provide additional lift to overcome the net, nose-down moments caused by both wings' pitching moments and the thrust and drag moments. This results in a level-flight foreplane wing loading of 46 ounces per square foot (of which 28 ounces per square foot were the result of the nose-down moment load) and an aft wing loading of 22 ounces per square foot. In a two-surface canard configuration, such a high foreplane loading would result in high-speed takeoffs and landings. It was calculated that, flaps up, the foreplane's airfoil C_L max of 1.25 and wing loading of 46 ounces per square foot would stall at 31mph, and landing speeds would be around 40mph. It was reasoned that slotted flaps were necessary to reduce landing speeds to acceptable levels.

In June 1994, the Wild Goose made a very successful maiden flight, expertly flown by my good friend Ken Starkey—president of the Montreal R/C Club and a pilot of outstanding skill. He has test-flown virtually all my designs in recent years. His appraisals of each model's peculiarities and performance have proven very valuable.

SPECIFICATIONS

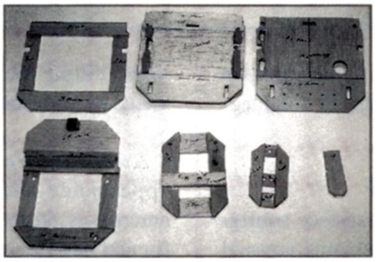
Wingspan: 56⅝ in.
Length: 43¾ in.
Wing areas:
—Foreplane: 225 sq. in.
—Aft plane: 450 sq. in.
—Horizontal tail: 112 sq. in.
Fueled weight: 97 oz.
Wing loading: 20.7 oz. per sq. ft.
Power: O.S.* Max .46SF
Prop: APC* 11x6
Power loading: 210.8 oz. per cid
Dihedral: zero degrees (both wings)
Airfoils: canard—Eppler E214; wing—Eppler E197; tail surfaces—Eppler E168.

Comments: the Wild Goose has three lifting surfaces, slotted flaps on the canard and on the wing. It utilizes the NASA "safe-wing" LE droop design on the aft wing. The model is built using balsa and plywood construction methods.



Final assembly of the fuselage; note the fin installation.

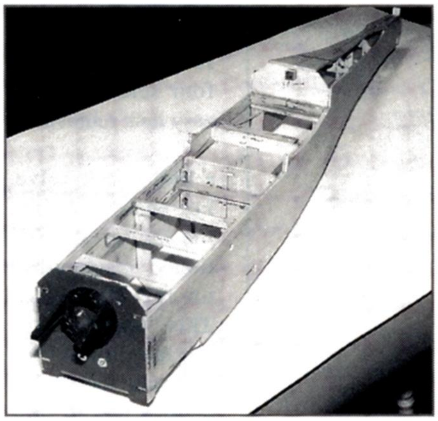
Two puzzling characteristics became apparent: Ken found the Wild Goose's elevator control unusually sensitive, and he made several graceful, nose-high landings, flaps up, at flying speeds more representative of the aft plane's wing loading of 22 ounces per square foot and substantially slower than the foreplane's high wing loading could be expected to permit. Subsequent test flights were made to establish the flap settings for flap-extended flight. Two critical factors are involved: both sets of flaps must be extended simultaneously; and the lift relationship between fore and aft wings must be maintained, flaps down.



The fuselage bulkhead sub-assemblies.

Control was effected with a Futaba* FP-8AP PCM transmitter, which has two proportional auxiliary channels. The left one controlled the foreplane's flap extension and the right controlled the aft plane's flaps. This permitted adjustment, in flight, of the flaps settings to achieve the balanced lift condition. Then disaster struck! During a flight to try those flap settings, the Wild Goose literally disintegrated, scattering components over a wide area.

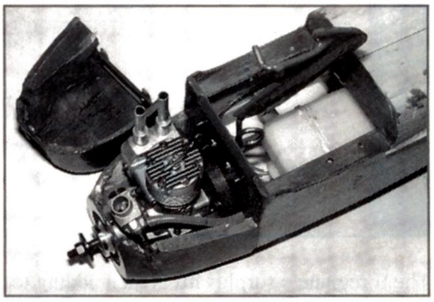
"Postmortem" examination of the collected "remains" revealed that one blade had broken off the prop and that the resulting intense vibration (about 8,000rpm) did the damage. The cause of the prop failure was traced to lack of clearance between the prop and the spinner. With the spinner snapped into its backplate, it exerted pressure on one blade causing a stress concentration that led to the failure. Spinner cutouts should clear the prop by a good ¹⁄₃₂ inch. Fortunately, both power and control units were undamaged; so during the '94/'95 winter, a second version was built using many undamaged components that had been salvaged from the wreckage.



Fuselage assembly.

In early 1995, the second version was successfully flight-tested by Ken Starkey. He reported unusual elevator sensitivity in the elevator high dual-rate setting. Flap settings were determined; surprisingly, both sets of flaps extended to 40 degrees, providing the mandatory balanced lift. Both flap servos were then Y-connected to the left proportional auxiliary channel so that all four slotted flaps would extend simultaneously. No pitch change occurred during flap extension, but a very noticeable reduction in flight speed took place.

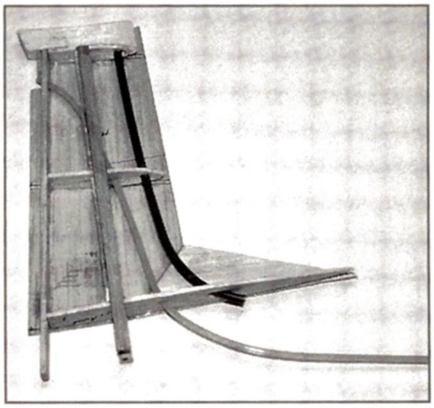
Landings, flaps extended, were found to require higher-than-idle engine rpm to overcome flap drag during the last few feet of the approach when the plane is flying almost parallel to the ground. This avoids a "solid" landing and permits a nose-high attitude on touchdown at a minimum speed.



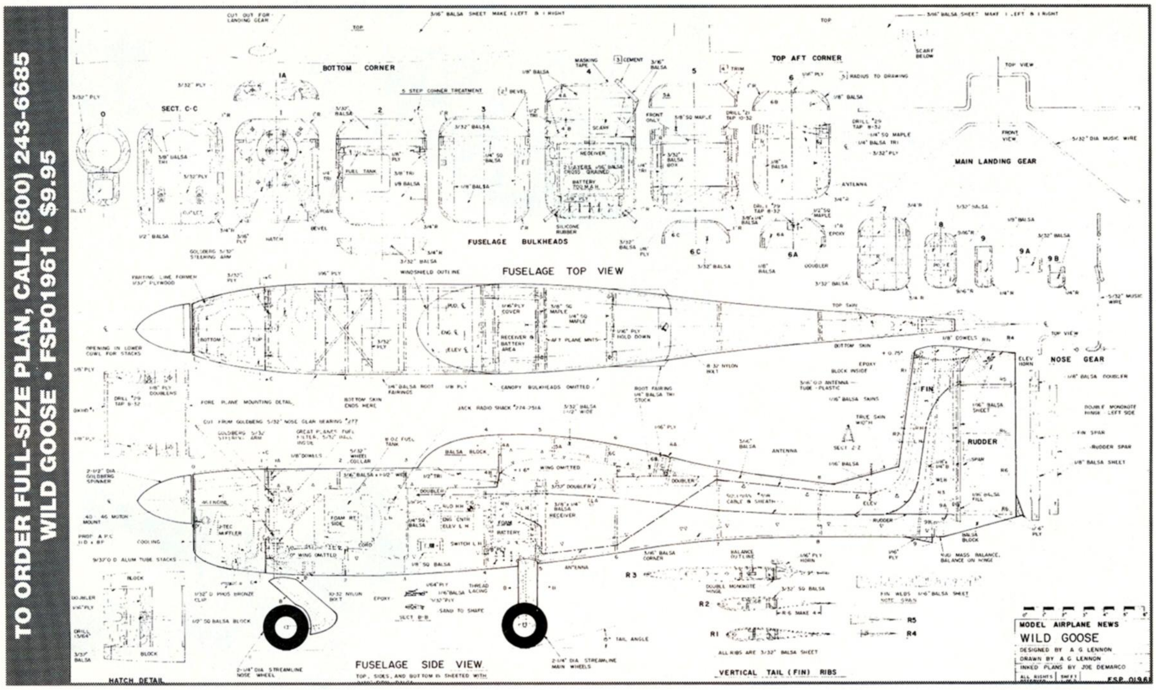
The painted cowl, open to reveal engine installation.

After much thought, the explanation for the elevator sensitivity and the slow landings, flaps up, was finally deduced. A conventional model (tail last) with its CG well ahead of its wing's center of lift will have a strong nose-down tendency that is overcome by a horizontal-tail download generated by up-elevator trim.

For a three-surface airplane in which the CG is well ahead of the aft wing's center of lift, the tail download caused by up-elevator action actually *reduces* the foreplane's load.



The vertical fin assembly in progress.



FSP01961 Wild Goose This unique, three-surface design by Andy Lennon flies beautifully. It's made of balsa and plywood, and intermediate builders will have no problems with its construction. The foreplane makes the elevator a little sensitive, so the pilot must take this into account when setting the initial elevator throw. Full construction notes come with the plans. WS: 56⅝ in.; L: 43¾ in.; engine: .46; 5 channels; 1 sheet; **LD 3. $9.95**

The foreplane's surplus lift is then adding to the up-elevator action. This accounts for both the elevator's sensitivity and the *very beneficial* reduction in landing speed—both flaps-up and flaps-down. This behavior is unique to the three-surface configuration. While the horizontal tail's download adds to the aft wing's load, this is easily handled because of its lower loading.

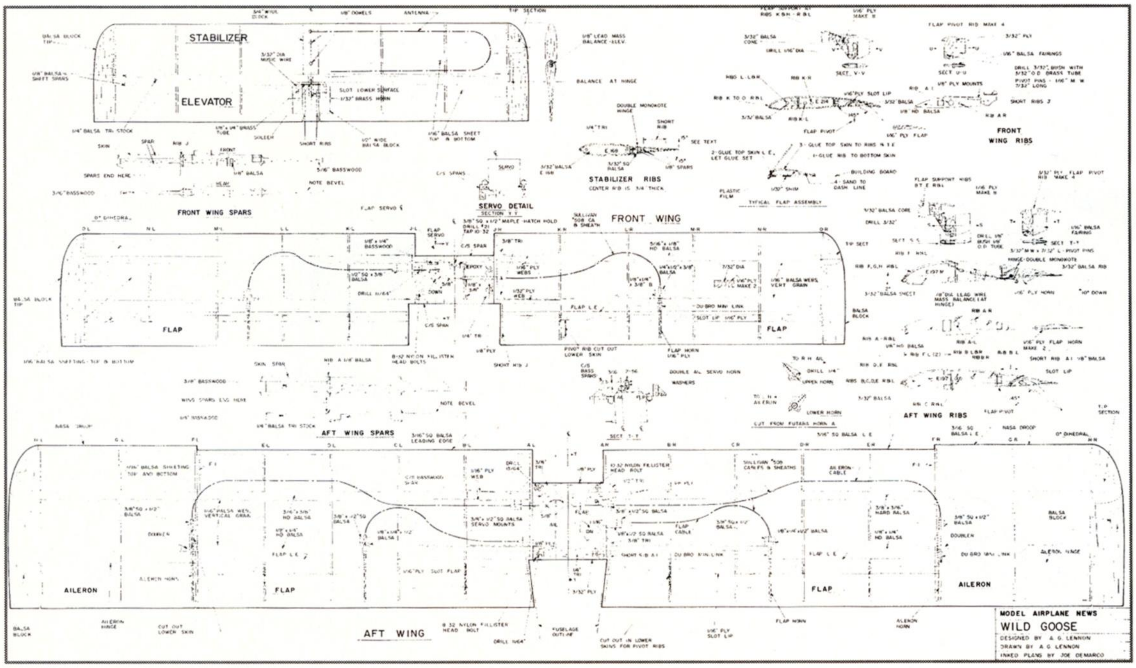
It is strongly recommended that elevator action be limited to approximately 15 degrees up or down by using the transmitter's elevator low dual rate adjusted to 15-degree throw, at least during early flights. Full 25-degree elevator action could stall both wings. Applying full up-elevator on takeoff could (and did!) result in a damaging crash.

FEATURES

In addition to its odd, three-surface configuration, the Wild Goose has some unusual features.

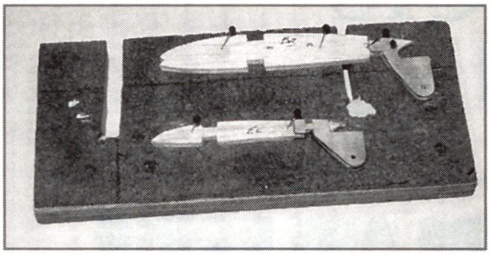
• **Canopy.** This extends to the aft wing's trailing edge and is held by two dowels up front and one nylon bolt at the rear. Its easy removal exposes all servos (except the foreplane flap servo), nose-wheel linkage and fuel tank for servicing or adjustment. Filling the tank, canopy off, permits visual monitoring of the filling process.

• **Antenna.** For reduced drag, better appearance and for its protection, the antenna is buried in the fuselage, vertical fin and one side of the stab. This requires a coupling in the antenna 4 inches from the receiver. Dismantled Radio Shack solder-type gang connectors (part nos. 276.1537; 276.1538) provide nine small, neat connectors. Measure the antenna length before cutting and again after the coupling halves have been soldered to the cut ends. Trim the antenna to its original length.



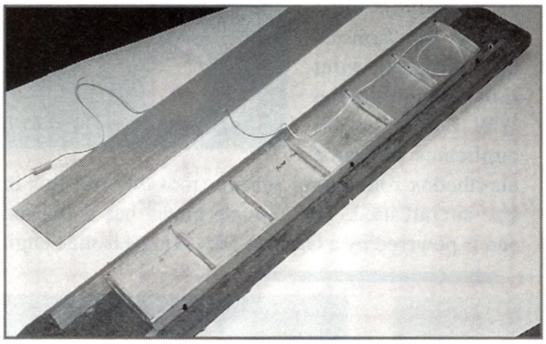
• **Tank installation.** The forward wing and its flap servo require that the tank be suspended and offset to the right. The suspending plywood also braces the fuselage top. The four screws permit easy tank removal.

• **Ball-check valve.** For easier starting, the model is positioned upside-down on the field box. This "uprights" the engine and avoids hydraulic lock, but it permits fuel to flow from the tank to the muffler via the muf-



The flap support rib assembly in progress.

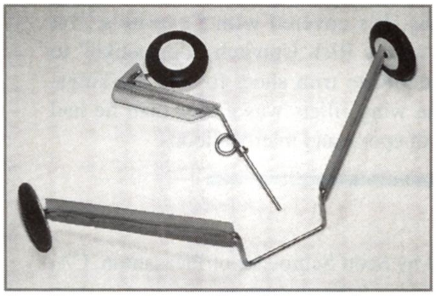
fler pressure fuel line. To prevent this, a "ball-check valve" is installed in the pressure tubing and positioned vertically. This valve consists of a Great Planes* in-line filter with a $\frac{5}{32}$-inch-diameter ball bearing inside, positioned so that it rests on the filter screen when the model is right-side up. Inverting the model permits the ball to fall into the unscreened portion and prevents fuel flow to the muffler.



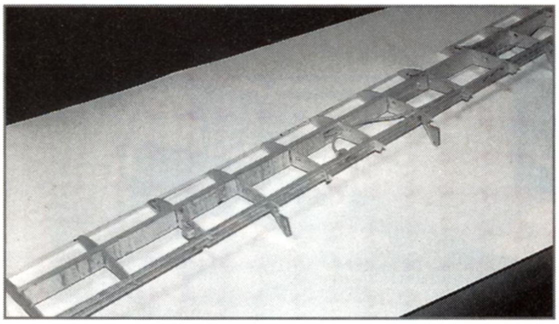
Horizontal stab partially assembled.

• **Lateral balancing.** To fly well, the model should balance, wings level, laterally. Lift the model by holding the upper prop tip in one hand and the top of the rudder in the other hand. Any imbalance will be apparent. Add weight to the lighter wingtip for balance. Du-Bro* $\frac{1}{4}$-ounce "stick on" lead weights embedded in the balsa tip are a convenient "fix."

• **Flap extension.** To extend the balanced flap to 40 degrees, the foreplane flap clevises *must* be in the holes in the servo horns $\frac{5}{8}$ inch apart ($\frac{5}{16}$ inch from the horn center). The aft-wing flap clevises are in the holes $1\frac{1}{16}$ inches apart ($\frac{17}{32}$ inches from the horn center).



Landing-gear legs with fairings and wheels installed.



The foreplane structure without the balsa skin.

• **Flutter prevention.** This model is fast, necessitating that ailerons, elevators and rudder be mass-balanced so that the CG of each control surface is on its hinge line. This is the only sure way to avoid damaging flutter. For ailerons, $\frac{1}{8}$-inch-diameter lead wire and for elevators and rudder, Du-Bro's stick-on lead weights buried in the shielded horns provide this balance (as shown in the drawings).

• **Remote glow-plug energizing.** A jack wired to the glow-plug along with a mating plug (both from Radio Shack) permit this energizing at a point well away from the dangerous rotating prop.

• **Cowl.** The design and construction of the engine cowl is detailed in "Ducted Cowl Design," in the August and September '94 issues. The easy removal and reinstallation of the lower portion is very convenient.

• **Flying.** The Wild Goose is not a highly aerobatic design, but it is stable and fast flaps-up and stable and slow flaps-down. Be conservative in takeoffs, and use modest power, above idle, for landing. For transportation, do not unbolt both wings—only the aft plane. The foreplane may be left installed.

Editor's note: this article does not cover construction of the Wild Goose, because detailed construction notes are included with the plans set.

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.*

■

PILOT PROJECTS

A LOOK AT WHAT OUR READERS ARE DOING

SEND IN YOUR SNAPSHOTS

Model Airplane News is your magazine and, as always, we encourage reader participation. In "Pilot Projects," we feature pictures from you—our readers. Both color slides and color prints are acceptable.

All photos used in this section will be eligible for a grand prize of $500, to be awarded at the end of 1995. The winner will be chosen from all entries published, so get a photo or two, plus a brief description, and send them in!

Send those pictures to: Pilot Projects, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897.

FOKKER V.1

Built by T. Boot of the Netherlands, this very unusual Fokker V.I was an experimental German fighter prototype built before the famous Dr.1 Triplane went into service during WW I. The model duplicates the same unorthodox roll-control system (movable roll tips instead of ailerons) that the full-size aircraft used. The $\frac{1}{3}$-scale model has a 104-inch wingspan, weighs 32 pounds and is powered by a German 50cc King gasoline engine.

FLYING COLLECT

Mike Morgan of Miami, OK, built this Carl Goldberg Models Ultimate bipe and finished it in Sean Tucker's famous 1-800-COLLECT Challenger paint scheme. Power comes from a SuperTigre .75, and the finish is MonoKote.

TEXAN OF ARABIA

Robert Hodes of Riyadh, Saudi Arabia, built this great-looking Midwest AT-6 and finished it with Spanish Air Force E-16 markings. The model is powered by an O.S. 1.08 engine and has Robart retracts installed in the wing. It's covered with Coverite's 21st Century fabric, and Robert used a Rich Uravitch "Cosmetikit" to dress up the model and MonoKote trim sheet for the markings. Robert says that making the wing fillets was easier than he had expected; he used a mixture of epoxy and microballoons.

MK IX ON FINAL

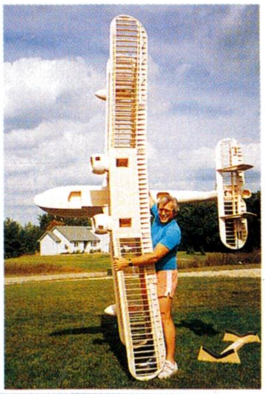
This Pica Spitfire Mk IX was built by Scott Schroeder of Pleasanton, CA, who modified it for scale competition. It has a custom muffling system with functional, scale exhaust stacks, and it's finished with fiberglass and latex paint that was computer-matched to authentic color chips. The $\frac{1}{5}$-scale model has an 88-inch wingspan and is powered by a Moki 1.8 engine. (Photo by Dan Parsons.)

CLASSIC AIRMAIL

This classic PA-5 Pitcairn Mailwing bipe is the work of Barry Yardley of North Swanzey, NH, who scratch-built it from Vintage R/C plans. It's powered by a 7-cylinder Technopower glow-powered radial engine turning a 15x6 prop. Barry controls the mail plane with a Futaba radio, and he covered the model with 21st Century fabric. It took nine months to build.

PILOT PROJECTS

SUPERMARINE STRANRAER



Built by Terry Overton of Oxford, MI, this impressive 1/7.2-scale Supermarine Stranraer flying boat took six months of spare time to build. It has a top wingspan of 12 feet and a total wing area of about 30 square feet. Its dry weight is 34 pounds. The model is built of balsa and plywood, and the fuselage (hull?) is covered with 3/4-ounce fiberglass cloth and finished with HobbyPoxy resin. Two YS 1.20 4-stroke engines turning 16x6 props

power the model, and a JR 388 radio and Hitec 1/4-scale servos control it. To improve water tracking on takeoff, Terry mixes the left and right throttles with the rudder.

DOLLED-UP CUB

Herman Acklen of Winchester, TN, modified a Great Planes Piper J-3 kit to produce this nicely detailed Cub. The model is powered by an O.S. .45 FSR engine, and it's covered naturally with Cub Yellow 21st Century fabric from Coverite. For improved appearance and roll response, scale, Frise-style hinges were added to the wing.

GULL-WING FIGHTER

This Top Flite Gold Edition F4U-1 Corsair was built in 3 1/2 years by Joe Filgas of McKinleyville, CA. It's powered by a SuperTigre .90 with a Slimline Pitts-style muffler, and it has Rhom-Air 90-degree retracts and scale Robart Robo struts, wheels and tires. The model has many scale extras that include an onboard voltage monitor and functional navigation lights.

MAJESTIC MONOCOUPE

Built by Carl Schurenberg of West Chester, OH, this Ikon N'west Monocoupe 90A is powered by a SuperTigre 2500 engine. It's controlled by a Futaba radio and is covered with Coverite's 21st Century fabric and paint. Carl won the Best Plane award at the Miami Valley Radio Club's annual static contest.

MILE-HIGH B-29

Al Pluckrose of Conifer, CO (center), sent this photo of a B-29 model that he was proud to test-fly for a fellow Mile Hi R/C club member. Al didn't give us the builder's name, but he said it took four years to build the plane, which has scale flaps and homemade retracts. The model was built from plans drawn by the builder who took the measurements from a full-size B-29 at Lowry AFB in Denver. The model is powered by four ASP .75 engines, has a 12-foot wingspan and weighs 50 pounds.

Understanding How Models *really* Fly

by JEF RASKIN

THE MOST COMMON explanation of how model planes fly (what I was taught in school and what you were probably taught) is wrong. Figure 1 is a typical example from a current book. I'm sure you've seen something like it before.

It is true that if you speed up the flow of air over a surface, the pressure on that surface decreases. This is calculated by using Bernoulli's equation. And it is also true that, in normal flight, the air does flow faster over the top of a wing. If, as many sources say, the increase in speed is proportional to the increase in length (as would be required if a pair of air molecules that separate at the leading edge come together again at the trailing edge), then when you work out the numbers, you get only a tiny fraction of the lift required. The sidebar, "The Numbers Just Don't Add Up," has the full calculation for one of my R/C models.

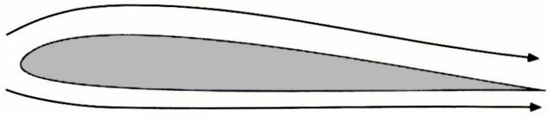


Figure 1. The common explanation from "The Way Things Work" (Macaulay, 1988). The cross-section of a wing has a shape called an airfoil. As the wing moves through the air, the air divides to pass around it. The airfoil is curved so that air passing above the wing moves faster than air passing beneath. Fast-moving air has a lower pressure than slow-moving air. The pressure of the air is therefore greater beneath the wing than above it. This difference in air pressure forces the wing upward. The force is called lift.

The common explanation also presents us with a puzzle: how can a plane fly inverted (upside-down)? After all, the curve is now on the bottom! When I pressed my sixth-grade science teacher on this question, he just got mad and said, "Shut up, Raskin!" Before I go on, I have to say that there are some "anti-Bernoullians" out there who claim that what we now call Bernoulli's equation is wrong. Well, Bernoulli's equation is correct (it is a form of the well-established law of conservation of energy). But you can't use it in the way some books and authorities try to. The common explanation of lift has led many famous scientists astray. If you are confused, you're not alone. For example, I was reading "The Surface Anatomy of Birds." It said, "The flat wings of a paper airplane don't create lift and can only slice through the air until they drop from lack of momentum." As any model-airplane builder knows, flat wings can create lift. The author was confused by the common—but wrong—explanation that seems to need two surfaces of different lengths to work.

Figure 3. For small models, this wing cross-section is very efficient, but there is almost no difference in the lengths along the top and bottom.

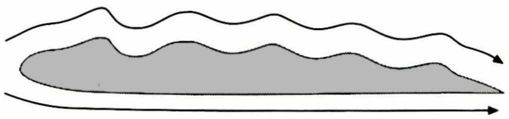


Figure 4. If we make the top of the wing like this, the air on top has a lot longer path to follow, so the air will go even faster than with a conventional wing. You might conclude that this kind of airfoil should have lots of lift. In fact, it's a disaster.

HOW WINGS FLY—NOT

You'd think, based on the common explanation, that a wing that's somewhat concave on the bottom (often called an "under-cambered" wing) would generate less lift (under otherwise fixed conditions) than a flat-bottom one. After all, the air has to go farther on the bottom than with a flat-bottom wing, so the pressure difference and lift should be decreased. As we all know from flying model airplanes, this conclusion is dead wrong (see Figure 2).

A very efficient airfoil for small, slow flying models is a curved, thin sheet of balsa, but it is not clear from the common explanation how it can generate lift at all (see Figure 3). If the common explanation were all there is to it, then we should be making the tops of wings curvier and longer. Then the air would have to go even faster to get to the back "on time," and we'd get more lift (see Figure 4).

The usual story we're told results in no

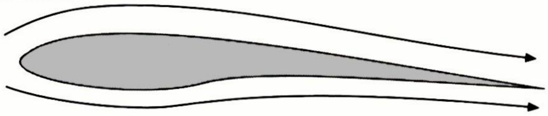


Figure 2. With an under-cambered airfoil, the bottom path is longer than with the flat-bottomed example above, so by the traditional explanation, this wing should generate less lift; however, it generates more. Hmmmm....

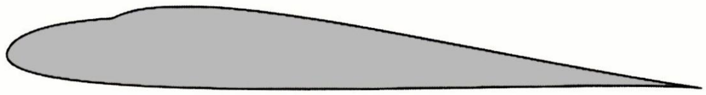


Figure 5. An extra lump for extra lift?

"That we have written an equation does not remove from the flow of fluids its charm or mystery or its surprise."

—Richard Feynman, 1964

"In aerodynamics, theory is what makes the invisible plain. Trying to fly an airplane without theory is like getting into a fistfight with a poltergeist."

—David Thornburg, 1992.

Figure 6. Albert Einstein's airfoil. It has no aerodynamic virtues.

convenient visualization that links the shape of an airfoil with its lift and reveals nothing about drag.

• **Albert Einstein's wing.** A flying buddy came up with a proposed improved airfoil (see Figure 5). This is just a "reasonable" version of the lumpy airfoil that I presented in Figure 4. I told him about Albert Einstein's WW I airfoil that was based on the same idea (see Figure 6). A plane built with this airfoil barely flew. Einstein later admitted that he had goofed; like my friend, he had been fooled by the usual explanation!

A WELL-KNOWN EXPERIMENT, REVISITED

Here's an old experiment often used in classrooms and on TV science shows to "prove" that the Bernoulli effect is what lifts airplanes.

Make a strip of writing paper about 2 by 11 inches. Hold it in front of your lips so that it hangs out and down, making a convex-upward surface. When you blow across the top of the paper, it rises. But what if the paper curves the other way?

Try it: form the paper into a curve that is slightly concave upward along its whole length. This strip will move up when you blow across it, even though there must be less pressure on the top (remember, the Bernoulli effect is quite real). Obviously, there is another effect that is even stronger (see Figure 7).

You don't need a multimillion-dollar wind tunnel to learn a lot. Here is one that can be built in a few minutes: make a box out of thin plywood or cardboard with a balsa airfoil held in place with ordinary pins that allow the foil to flap freely. Air is introduced with a soda straw and flows across the top of the foil. That's one of the nice things about science. You don't have to take my word on this; you can try it yourself! (See Figure 8.)

• **What the miniature wind tunnel does.** When you blow into the straw, the normal airfoil promptly lifts off the bottom and floats up. When the blowing stops, it goes back down. This is exactly what everybody expects. But now, try an airfoil with a concave shape. I cut the two airfoils out of the same piece of balsa so that the curves were exactly the same. If the common explanation were true, then, since the length along the concave foil is the same as that of the "normal" example, you'd expect this one to rise, too. Surprise! The concave airfoil stays firmly down; if you hold the apparatus vertical, it will be seen to move away from the airflow. They

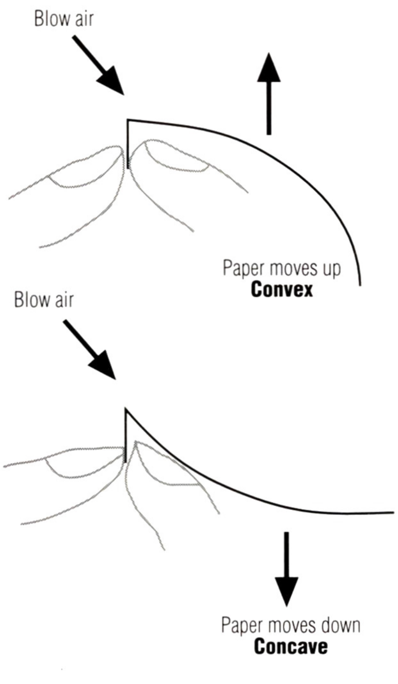


***Figure* 7. The paper experiment**

The Numbers Just Don't Add Up

The force you get by applying the Bernoulli equation in the way implied by the common explanation of lift is nowhere near enough to fly a plane. For doubters, here is the calculation worked out in detail. I will call the pressure on the top and bottom of a wing "p_{top}" and "p_{bottom}," the average velocity on the top and bottom of the wing "v_{top}" and "v_{bottom}," and use "r" for the density of air (approximately 0.08 pound per cubic foot). The pressure difference across the wing, owing to its motion through the air, is given by the first term of Bernoulli's equation: $p_{top} - p_{bottom} = \frac{1}{2} r\,(v_{top}^2 - v_{bottom}^2)$. A rectangular planform (top view) wing with a 40-inch span had a length chordwise along the bottom of 6.394 inches, while the length across the top was 6.441. The ratio of the lengths is 1.0074. This ratio is typical of many model and full-size aircraft wings. According to the common explanation, which has two adjacent molecules separated at the leading edge meeting at the trailing edge, the average air velocities on the top and bottom are also in the ratio of 1.0074. A model plane with about a 40-inch span and a 6-inch chord with a weight of about 25 ounces can fly at 20mph, so v_{bottom} is 20mph, which makes v_{top} 20.148mph. Given these numbers, we find a pressure difference from the equation of about 0.0013 ounce per square inch. The wing area is 240 square inches, giving a total force of about 0.3 ounce. It misses lifting the weight of 25 ounces by a lot. A "back-of-the-envelope" feel for the lift generated by the Coanda effect is not difficult: we know that biplane wings should be set at least a chord-length apart to avoid most of the interference effects, so we know a wing affects the air for at least ½ a chord length above and below it. We can consider that our 40x6-inch wing affects a "block" of air about 12 inches thick. This air weighs about 2 ounces.

Our model is flying at 20mph (30fps), and the block of air is accelerated from stationary to about 10fps downward (a number estimated from flow-tunnel photos) in the 1/60 second it takes the wing to move its own length (6 inches) through the air. The average acceleration of the air entrained by the Coanda effect is therefore about 300 feet per second squared. How much force upward does this produce? Newton's famous equation tells us that force equals mass times acceleration. Mass in the antique English system we use in the U.S. is measured in slugs. Two ounces is about .06 slug. Multiplying mass by acceleration gives us a force of about 18 ounces. For a rough estimate, this is amazingly close to the 25-ounce weight of the model (especially when compared with the Bernoulli calculation!). Even on a numerical basis, then, thinking in terms of the Coanda effect gets us a lot closer to understanding how a plane flies.

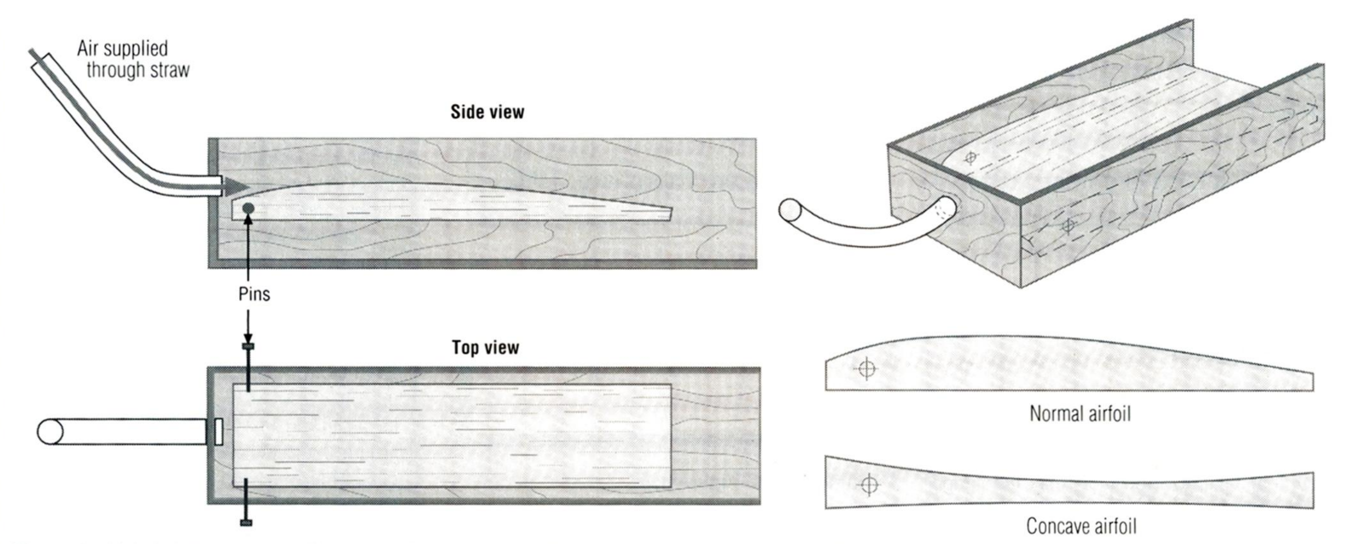


Figure 8. Airfoil demonstrator. These drawings are not full-size, but the exact size and shape aren't important. Here are two airfoils I tested in the wind tunnel.

never try this experiment in science classes! A clearer picture of how lift works is based on the Coanda effect, studied in the 1930s by the Romanian physicist Henri-Marie Coanda.

THE COANDA EFFECT

If a stream of air (or another fluid) is flowing along a solid surface that is curved slightly away from the stream, the stream will tend to follow the surface. This is the Coanda effect. Hold the back of a spoon vertical under a thin stream of water from a faucet. The water curves around the bottom of the spoon. If you hold the spoon so that it can swing, you will feel it being pulled toward the stream of water (see Figure 9). The effect has limits: if the surface is too sharply curved, the water will just bend a bit and break away.

The bending of streams of air or water to follow a surface is the key to better visualization of how airplanes fly, how ailerons, elevators, rudders and flaps work and to some of the causes of drag (see Figure 10). The word "entrained" is often used to describe the Coanda effect, e.g., the airstream is entrained by the surface.

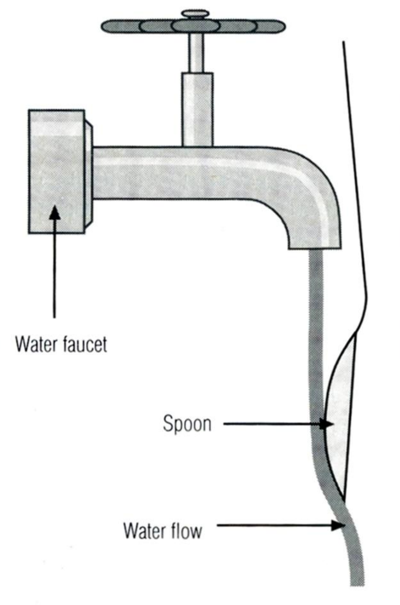


Figure 9. The water follows the surface of the spoon—an example of the Coanda effect.

• **Visualizing lift and drag.** The air flow across a wing is entrained to follow the surface of the wing. This means that we can think of the top surface as "pulling" at the air, making it come closer. It is this pull that generates most of the lift. But the wing is also trying to pull the air forward, which helps us understand one source of drag associated with lift. On the bottom of the wing, the air is also entrained and forced downward. This, too, generates lift and some drag, since the air is also pushing back against the wing. When you picture it this way, you see that the upper and lower surfaces of a wing work independently and that lift can not be had without drag in either case. There is much more than this to the physics of lift, but the nice thing about this visualization is that it gives a good feel for how differently shaped wings operate. For example, since air is entrained more easily by gentle curves, we can understand that the sharp bend that air has to take to get around the leading edge of a flat wing decreases its efficiency compared to a curved surface. The miniature wind tunnel is readily understood in terms of the Coanda effect: the convex (normal) wing entrained the airflow to move downward, and a force upward is developed in reaction. The upward-curved (concave) airfoil entrained the airflow to move upward, and a force downward was the result. To be sure, the lowered pressure on top was pulling upward, but the Bernoulli effect is

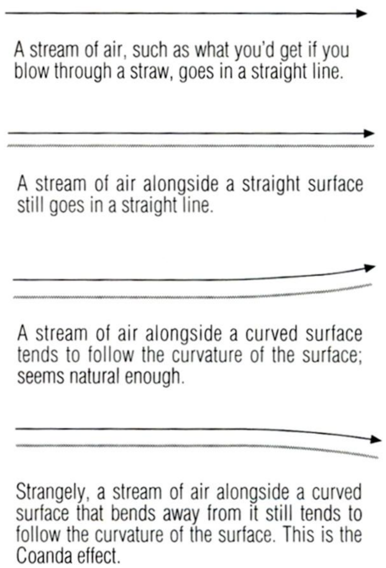


Figure 10. Airstreams tend to follow the surfaces of objects near them.

a weakling compared with the Coanda effect. The lumpy wing generates a lot of drag by moving air up and down repeatedly. This eats up energy (by generating frictional heat) but doesn't create a net downward motion of the air and, therefore, doesn't generate lift. Based on the Coanda effect, it is easy to visualize why the angle of attack (the fore-and-aft tilt of the wing) is crucially important to a symmetrical airfoil, why planes can fly inverted, why flat and thin wings work, and why the experiment with the convex and concave strips of paper works as it does. It's impossible to visualize these things with the simple Bernoullian explanation. While thinking in terms of the Coanda effect is far more useful than trying to understand how planes fly using pressure differences, there are limits to its helpfulness. For example, it does not explain why thin wings (like the bent sheet of balsa) are better for small, slow models and thick wings (like a Clark-Y or Eppler airfoil) are better for larger ones. Of course, naive Bernoullian analysis is even worse!

Figure 11. Air can't usually do what is shown here and follow a surface that's too sharply curved.

• **Some refinements.** There's a lot more the Coanda effect can help us to see. It should come as no surprise to anybody who rides a bicycle or drives a car that it is harder to turn a sharp corner than to go around a gentle bend. The same is true of air (see Figure 11).

If you go around a corner too sharply in a car, you are likely to spin out. When this happens in air, it is called turbulence (see Figure 12). The air moves irregularly, spins in little whirlwinds (called vortices) and otherwise wastes energy—energy that your plane supplied. In a power model, this may not be too important (unless you're racing or have barely enough power) but, with sailplanes, it's more important.

Figure 12. If an aircraft shape bends too sharply, the airflow will become too turbulent and will no longer follow the surface.

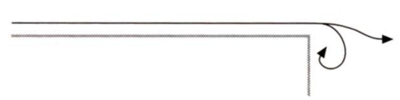


Figure 13. A shape that occurs too often on models is a square corner. It causes a lot of wasteful drag.

To move air takes work. Every bump or hollow on the model moves the air sideways as it tries to follow the shape of the model, taking energy and causing drag. Square edges, which are much too sharply bent for the air to follow, are dreadful generators of turbulence (see Figure 13).

This is also why trailing edges, where there is flow on both sides, should be as sharp as practical if minimizing drag is important. The flows on top and bottom can join each other smoothly (see Figure 14).

THE PRINCIPAL'S OFFICE

Back in the sixth grade, I tried to convince my teacher that his explanation was wrong by coming in with a balsa model. It had flat wings and aluminum-foil elevators. I demonstrated that the plane would glide with either side up, depending on how the elevators were set. The result? I was sent to the principal's office with a note saying that I had been flying paper airplanes in class. The next day, I went to the library and found that the books agreed with my teacher! It was one of the great moments in my life to learn that the available "authorities" could all be wrong and that an individual could find this out for himself.

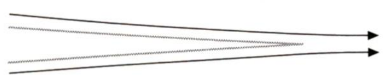


Figure 14. A pointed trailing edge is more efficient than a square or rounded trailing edge.

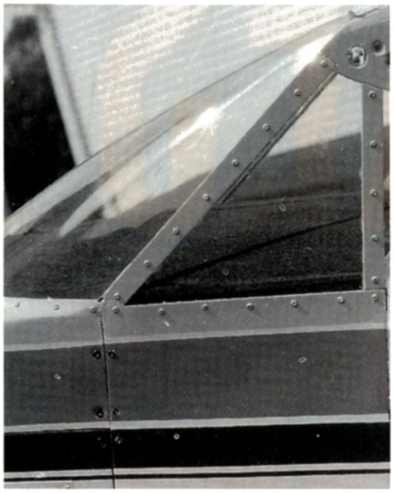
Editor's note: E-mail can be sent to the author at jefraskin@aol.com. Letters will be answered if sent c/o this magazine with a stamped, self-addressed envelope. The author, who has designed many commercial airplane kits, is a contest director and a life member of the AMA. He is best-known in computer circles for having created the Macintosh project at Apple. ■

BOB UNDERWOOD

REPRODUCING POP RIVETS AND SCREW HEADS

HOW ABOUT that airplane! It's exactly the model you've been looking for! True, it's a homebuilt, but the lines are pleasing, and the color scheme is striking. You've already got a good 3-view for it, and the owner would love to have you model his creation. The airport is right in your hometown! What more could you ask for? Where's the camera?

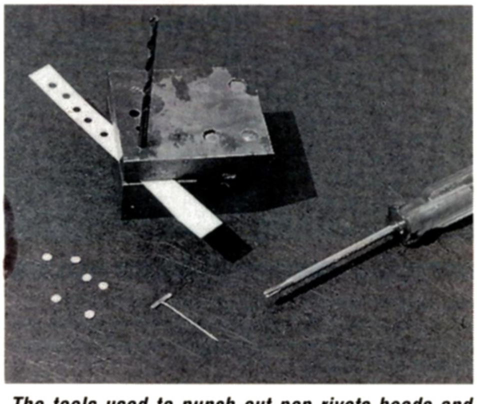
A set of circumstances like this seldom happens. Usually, the aircraft is inaccessible, the only one ever built crashed 60 years ago, the owner isn't willing to cooperate, or what have you. So there must be a catch to your find. Often the "catch" is some element that is difficult to duplicate in model form. In my last column, we helped you solve the spinner problem. But other roadblocks can occur. Wheels, markings and unusual configurations are but a few.



These Phillips-head screws around the windshield of my Hiperbipe are actually fake! Painted silver to resemble a metal finish, they add lots of realism to the completed model.

WHAT'S THE CATCH

So what was the catch to this find? Being a homebuilt, it is liberally sprinkled with pop rivets and Phillips-head screws. Now, there's a chance that if you build the model to just the right scale, you *might* be able to locate Phillips screws that match the ones used on the full-size plane. The operative word is might! And that should be preceded by, "If you're really lucky you...." When it comes to finding a ¼-scale pop rivet to duplicate the original, the phrase "lots of luck" becomes wildly optimistic.



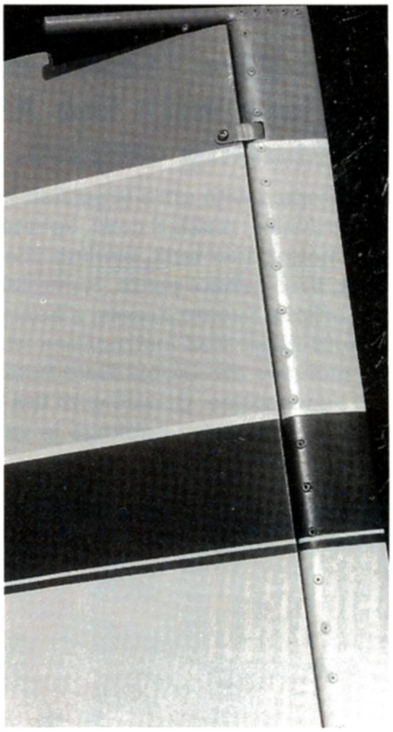
The tools used to punch out pop rivets heads and screw heads. A metal block with a slot cut into its side and a hole drilled through it works great as a punch die. I use .010-inch-thick plastic from Sig to make the rivets and screws. Also shown is a modified Phillips-head screwdriver used to emboss the heads of the replicated screws.

So-o-o, you're going to dump the project? No way! Just make your own Phillips-head screws or pop rivets in any size head you need! Notice I said "head!" That's because you aren't really going to produce an actual screw or rivet, but will fake the head so your model will look like it's held together with those types of fasteners. Remember, creating a scale model more often than not is an illusion. It's not always reality.

FAKE SCREWS AND RIVETS

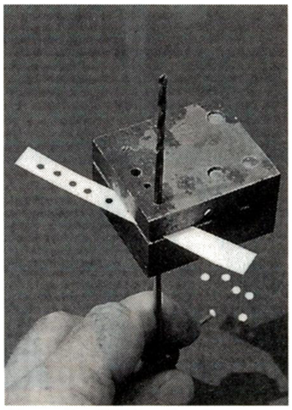
It was a neighbor (a non-modeler, I might add) who helped me develop the technique for producing screw and rivet reproductions. I had tried a variety of techniques involving glue drops and stamping processes to simulate the heads. None of these proved satisfactory for one reason or another. The neighbor, Dick, suggested the heads be punched from some material. Actually, he even provided the metal block with a slot for a die.

The next step was to determine the diameter needed for the screw or rivet-head representation. If you were thinking ahead when you first saw the subject aircraft, then you probably measured them. It not, some form of guesstimation may have to suffice. At this point, you may be subjected to your first lesson in "scale psychology." As far as surface detail is concerned, it is almost always better to understate rather than overstate the representation.



Along the leading edge of the Hiperbipe's aileron (also at its tip), pop rivets complete the scale illusion. Again, they're made of punch-out, thin plastic disks.

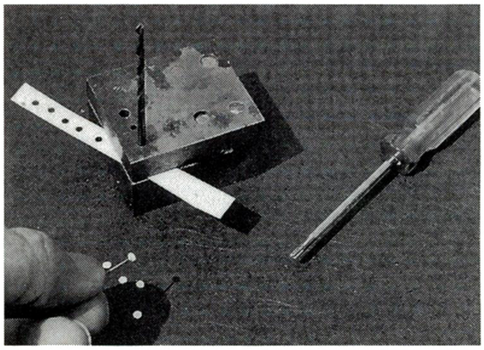
In short, keep it smaller. This becomes even more true as the model becomes larger. The viewer becomes more sensitive to detail items in a $^1/_3$-scale model than on a $^1/_4$ or $^1/_5$ scale. You can argue "exact" all day, however, people (even modelers) have a real hangup when you try to explain that a model is "$^1/_3$ the size of the original." They often have problems comprehending the concept. When their eyes see screws and rivet heads that are the correct size, their brains see them as too big.


To make Phillips-head screws, place the modified screwdriver in the bottom hole and the drill-bit punch in the top hole. The screwdriver is ground down so it bottoms out below the slot in the die block, and it requires two taps with a hammer to make a duplicate screw head.

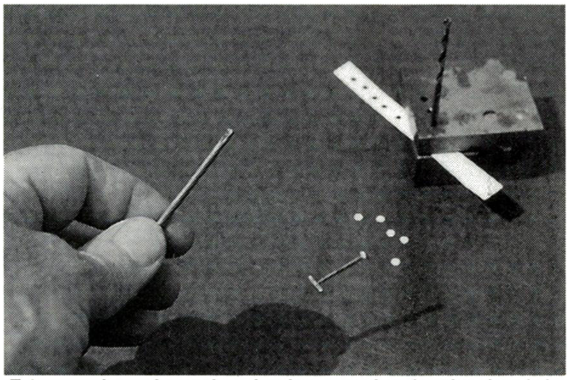
Now, let's drill a hole in our metal piece that we will be using for a die. Run the hole right down through the slot and out the bottom of the block. At this point, you need a metal piece to act as a punch. A simple solution will be to use the drill bit you just ruined by running it too fast, with no lubricant, through the hard metal block! (Ah, yes, experience can be such a valuable teacher!)

Next step? Let's find something to use to punch out the representations of the heads. My search took me through a variety of "stuff" including litho plates, foils, etc. What worked? I found the .010-inch plastic material sold by Sig Manufacturing* to be perfect. I slid a piece in the slot, placed the chuck end of my ruined drill bit in the hole, tapped it with a hammer, and a little, round, dome-shaped piece popped out the bottom of the metal block. Actually, I found it necessary to dress the end of the drill a bit to achieve the right amount of "dome-ness" on the plastic piece. You can form a pan or rounded head, or whatever is required.

Onward! Now that I had a bunch of little, round, domed pieces of plastic, a means of attachment had to be devised. (Actually, at this stage, they really didn't look like pop rivets!) The process that ultimately developed was to drill a hole, using a tiny numbered drill in my Dremel, wherever a rivet was to be placed. You'll have to experiment a bit, because the diameter-to-rivet representation and the straight pin used to apply it are factors in how big the hole needs to be.


A future scale pop rivet ready to be glued into place on the model. The pop rivet look is accomplished by pushing the pin point through the plastic disk and into a previously drilled hole in the model where the final rivet will be located. It takes practice to learn how far to push the pin for the desired effect.

I used the straight pin to flip the piece over (remember, they come out of the die, domed side down) and then picked it up by pricking it with the pin point right in the center of the dome. A very small amount of glue (such as Pacer's* Formula 560) was applied to the back of the piece. Centering the plastic piece over the hole, pressure was applied to the pin, and that pushed the point into the hole. With the correct amount of pressure, the plastic will collapse in the center, leaving a ring that looks like a pop rivet. It sorta looks like one half of a somewhat flattened bagel.


To properly emboss the plastic screw heads, the tip of the Phillips-head screwdriver must be ground or dressed with a file to remove the point of the cross.

MINI PHILLIPS

To create a Phillips screw head, it is necessary to find a cheap (the cheaper the better) Phillips screwdriver with a shank that is larger in diameter than the hole in the metal block. Grind or file the tip of the shank so that it just fits the hole, but bottoms out with the tip below the slot in the block. Grind or file off the point of the tip, and carefully dress the + portion to the proper size of the Phillips + mark. It takes some experimentation.

To make a Phillips-head representation, follow the same process as the pop rivet, except place the ground-down-shank in the hole from the bottom of the block, support the metal block and screwdriver in contact with your workbench, and tap *twice* with the hammer. The first tap will punch out the head, and the second one will imprint the + representing the Phillips slots. Glue it on the same way, except you won't need to pre-drill a hole. Neat, huh?

RIVETING THOUGHTS

1 The Sig plastic is white, so if your aircraft is white, you're home free. If

it isn't white, then experiment with when to apply the rivet/screw representations during the painting process. Quite frankly, if you are one who lavishes copious paint on a model, you may have a problem.

2 If the rivet/screw heads are left in a natural metal state on the full-size aircraft, then paint the plastic with silver or aluminium paint *before* you punch them out.

3 You may want to experiment with other glues; however, the RC 560 allows the most latitude in adjustment and replacement. I tried CA and found it problematic.

4 Punch out the heads in small quantities (maybe 10 to 20 at a time), then apply them. It breaks up the tedious nature of each part of the job. For the rivet heads, you can punch out a half dozen or so before you push them through the metal block. The Phillips are, of course, a one-at-a-time operation.

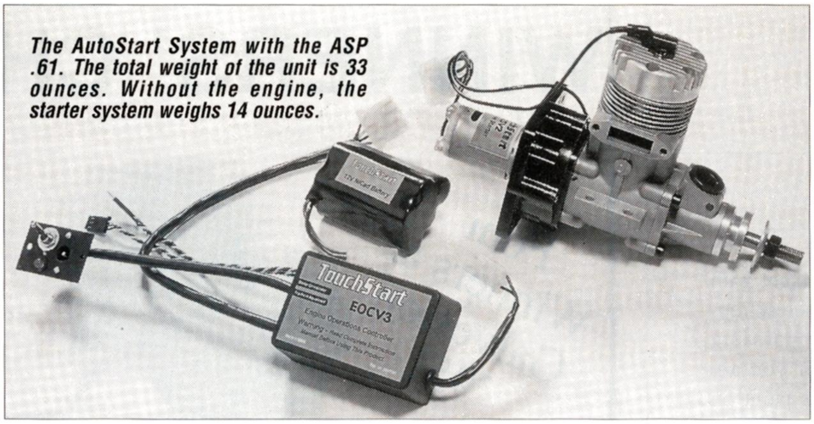
5 If you have allergies, find somewhere to direct your sneeze other than at the pile of punched-out heads! Weighing practically nothing, they will scatter to every recess of your workshop with even a modest ka-choo! I've been there—done that!

6 How about time? Yep, they take time to produce. I suspect the total time from beginning to end figures out to about one minute per head. My most recent Hiperbipe project consumed about 10 hours. Not worth it, you say? Have you ever thought about Pattern?

And to end with a thought for the day: plan ahead; remember, you can't cut the piece longer!

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

PRODUCT REVIEW



The AutoStart System with the ASP .61. The total weight of the unit is 33 ounces. Without the engine, the starter system weighs 14 ounces.

TOUCHSTART INC.

The AutoStart System

by ROGER POST JR.

Engine control from the transmitter

HAS YOUR engine ever quit while you were taxiing into takeoff position? Are you tired of taking all that starting equipment to the field? If your answer to these questions is "yes," read on for a solution to what ails you.

Developed over the past four years, TouchStart's* unique AutoStart System allows you to start your engine by means of your transmitter—no more "hand-starts" or dead-stick landings (as long as you don't run out of fuel as I did once).

THE SYSTEM

The AutoStart System consists of an electric starter, a 12V Ni-Cd battery pack and the engine operations controller, and it comes with a hand-selected ASP .61 engine and muffler. Total weight, including the engine, is 33 ounces (14 ounces without engine), and there's a 90-day limited warranty.

• **Electric starter.** This electric motor is attached to the back of the engine. A tough, thermoplastic housing protects the high-performance planetary transmission (a dual set of planetary gears with a 60:1 ratio). The high-speed gears are made of Delrin plastic, and the low-speed gears are made of 2024-T-4 aluminum. Where you put the grease and how much of it you use in the gears is very important to the transmission's operation (the manufacturer doesn't recommend that you disassemble the transmission yourself). The over-running clutch is a Torrington clutch—the drawn-cup roller type with one way-needle bearings that are used for lock-up. The power from the transmission passes through the over-running clutch to an output shaft and drives the engine's crank-pin. The engine is attached to the starter by means of a custom backplate adapter.

• **Battery pack.** Rated at 270mAh, the pack consists of 10, 1.2V Sanyo cells wrapped in black heat-shrink and wired with connectors. Charge it overnight (14 to 16 hours) with a Futaba* transmitter charger. The charge jack is a center/positive, outside/negative type, so be sure that your charger matches this configuration. A fully charged pack can give approximately 40 starts.

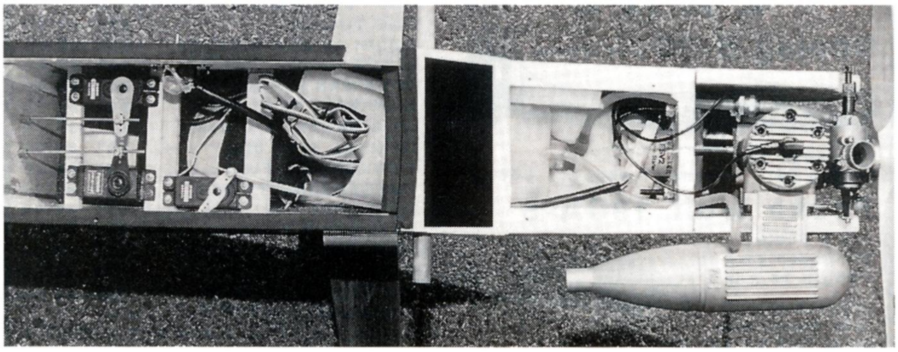
• **Engine operations controller (EOC).** This solid-state module controls the throttle, starter and glow plug when you start the engine. It's optically isolated, so there's no electrical connection between the battery pack and the receiver. This allows information to be passed from the EOC to the engine without any noise interfering with the radio; and the cables are all Belden shielded. The EOC can also read what the engine is doing and can increase the glow-plug current if necessary. The charge jack, arming switch, servo and receiver leads and the wires that are connected to the battery and starter are all attached to the EOC. The EOC is compatible with PCM systems, and it comes with connections that allow it to be used with Futaba J, Airtronics, Hitec and JR systems. Use the JR connector with a Hitec system.

INSTALLATION

Installing the system is not difficult. Read the instruction manual in its entirety; it discusses, logically and in great detail, how to set up the EOC and the engine properly, so follow the sequential setup steps, and note the safety precautions. You'll need a plane that can handle a .61-size engine and support the weight of the system; I chose the Hobby Lobby* Telemaster 40.

Be sure to have a solid, secure firewall for the engine. The manufacturer suggests 5-ply, 1/4-inch-thick plywood; it must be able to take a central 1 1/4-inch hole without being weakened. Cut the hole in the firewall with a 1 1/4-inch hole saw so that it will accept the electric starter motor. To secure the engine on the firewall, I used 1 1/2-inch no. 8x32 machine screws, thin rubber washers (placed between the mounting plate and the firewall), blind nuts and nuts with plastic inserts.

The shielded cables that connect the EOC to the electric starter are quite stiff, so the positions of the EOC and battery pack are pretty much set. I installed the battery pack for the system under the elevator and rudder servos and put the EOC beside the throttle servo. The receiver went in front of the EOC and directly behind the fuel tank. To accommodate the length of the electric starter, the fuel tank has to be



A top view of the installation; notice the thickness of the firewall. The battery pack and the EOC are wrapped in foam and installed near the servos. Details on how to install the setup are in the article.

moved slightly rearward, so plan your fuel lines accordingly. The receiver battery pack went under the starter motor and, believe it or not, the airplane balanced perfectly with this setup.

If you run into any problems, the AutoStart System's developer, Paul Thonnard, will be more than happy to help you out; call (904) 893-5339.

AT THE FIELD

When the engine has been broken in, the AutoStart System works as it should. The very first time I tried AutoStart, my engine started immediately, but it would not restart as anticipated. This was because the engine hadn't been broken in, and the low-end adjustment was very rich. Constantly cranking the system when the engine is flooded wears down the battery and results in a failure to start. The directions clearly tell you not to crank for more than 30 seconds at a time because of heat build-up. The extreme internal temperatures that result from constant cranking can permanently damage the starter-motor brushes and the battery pack. Before attempting a restart, you must allow at least 3 minutes for cooling. Sometimes, the plug "fouls," so carry an extra one with you.

I found that the best way to break in the engine was to disconnect the wire to the glow plug (remove the little setscrew and set it aside), keep the system turned off, and use a hand-held starter and glow driver to start the engine. This avoided wearing out the system and the battery pack.

After running the engine and flying the plane several times, I was able to set the low-end adjustment so that it didn't flood the engine. With this taken care of, I reconnected the glow wire, turned on the system and fired up the engine. It worked perfectly.

I put the plane into the air, shut off the engine and tried to restart it. Ah...the sweet sound of success; it started right up. I did this in the air twice more before I ran out of fuel. AutoStart is great for modelers who want to be able to start a scale plane in a scale-like manner.

When properly broken-in, the ASP .61 performed beautifully. I tried several propellers and found that a wooden 12x6 worked best. On a day with a 15-knot wind, I flew the Telemaster 40 with the 12x6 prop, and the plane didn't even notice the wind! (My thanks to Roger Post Sr., Mike DeHoyos, Dave Morgan and Dave Baron for their help at the field.)

As with all new products, patience and some experimentation are necessities. It didn't take long to get this system working, but it did take trial and error to perfect. If you follow the manufacturer's directions and the few hints that I have provided, you'll master AutoStart quickly. For your next .60-size plane, try it; you won't regret it.

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

A Few Words to the Wise

The AutoStart System is engaged when your throttle stick is all the way down and the throttle trim is then brought all the way down. This is usually how you *shut off* your engines, so you must develop a new way of thinking to shut down. You don't want to inadvertently start the system by doing what has become a habit during all those flying years.

Having a checklist attached to my transmitter worked best for me.

Starting Procedures

1. Turn on the transmitter.
2. Turn on the airborne pack.
3. Go to full throttle.
4. Choke the engine.
5. Bring the throttle *stick* all the way down.
6. Turn on the arming switch.
7. Go to the back of the plane, and hold the rudder with your right hand.
8. Bring the throttle *trim* all the way down, and start the motor.
9. When the engine starts, quickly push the throttle *trim* to its top position.
10. Check the engine settings and then fly.

Shut-Down Procedures

If you land dead-stick without fuel:

1. Turn off the arming switch.
2. Turn off the airborne pack.
3. Turn off the transmitter.

If you land with the engine running:

1. Shut engine off by moving the throttle *trim* lever three-quarters of the way down.
2. Turn off the arming switch.
3. Turn off the airborne pack.
4. Turn off the transmitter.

Under no circumstances should you bring the throttle stick and trim all the way down—unless you're prepared to start the engine!

HOW TO

Drill Bit Tips

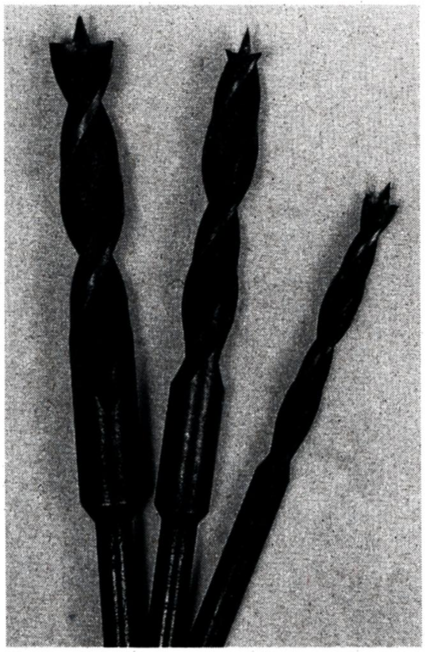
A workshop guide for improved results

by GERRY YARRISH

WHAT'S THE BIG deal? All you want to do is drill a simple hole. OK; but do you have trouble drilling aluminum motor mounts or thin sheets of metal and plastic? We all want clean, professional results, and no one wants to spend more money than they have to on tools. When you work on your model, do you burn up bits and constantly buy new ones? Do you have trouble with drill bits breaking or walking off the location you've marked for the hole? If so, this refresher course should help you.

TYPES OF DRILLS

Some modelers may be surprised at the variety of drill bits available other than just the simple twist drills sold at hobby shops and hardware stores. Here are some of the most useful drills I have on my workbench.



Brad-point bits are much better suited to drilling wood than the common twist drill bit. The Brad Point bit starts cutting material at its outer edges and produces a clean hole in balsa and pine.

• **Common twist drill.** These drill bits are used primarily for mild steel and nonferrous metals such as aluminum, brass, magnesium, etc. Modelers often use these bits for all their wood-drilling needs even though other bits do a better job. The greatest incentive for using these is availability; look anywhere tools are sold, and you'll find them. The best way to buy drill bits is in a set, or in a complete package known as a Drill Index Box, but these cost more because they can include anywhere from 8 to 100 bits. The main problem with twist drills is that, at the entry and exit holes, they produce burrs and chips, which require additional work to clean the edges of the holes.

• **Brad-point bit.** These drills are much better for drilling into wood, and they don't produce nearly as many burrs as twist drills. The brad-point bit is a hollow ground bit, i.e., it has a negative (almost straight) cutting surface angle. A common twist-drill bit starts cutting from its center point; but a brad-point bit starts cutting from its outer edges. This forces the chips and burrs into the hole and up the drill flutes instead of out the hole.

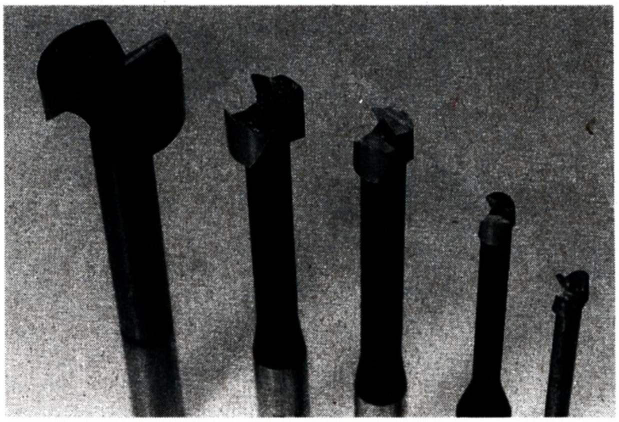
• **Forstner bit.** To me, these drill bits are like gold. They are expensive (more than double the cost of common twist drill bits), but the fine results you get more than justify the cost. This bit is a combination fly cutter and brad-point bit all in one. It removes wood much like a milling bit removes metal, and it doesn't produce large chips or burrs. Also, this bit is much less prone to walking off center, and it's much stiffer and doesn't bend when in use.

Common twist drills are the most widely used type of bit modelers use. They are best-suited to drilling mild steel and non-ferrous metals such as brass and aluminum.

For hard balsa, plywood and thin sheets of plywood, fiberglass and plastic, it can't be beat!

• **Combination drill and countersink.** These are best for thick (1/4 inch and thicker) metals, and they produce a countersunk hole that guides and supports larger-diameter bits used to drill the finished hole. These are also used as center drills for lathes when a true center hole needs to be drilled into a round piece of metal stock. These drills are very short and very rigid to minimize run-out.

• **Spade bits.** These bits are best suited to industrial drilling in which precision is not key. These bits can be used to quickly remove material from block balsa and pine. To use a spade, you must clamp the wood properly and use it with a drill press to minimize wobble. This is my very last choice for model use.



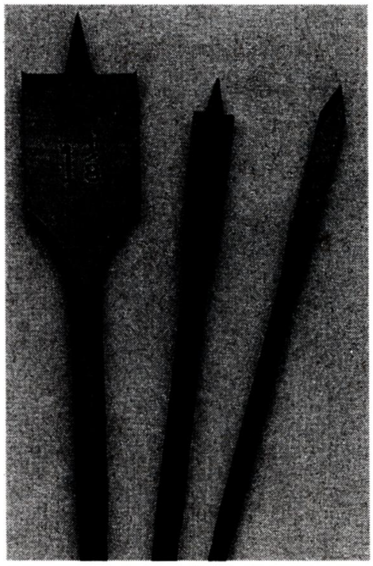
DRILL USES

• **Metal.** As I said, the common twist drill is best suited to drilling metal. Aluminum landing-gear mounting holes, engine mounts and brass or aluminum mounting

The Forstner bit is like gold! It produces the most precise hole in wood and comes in many sizes. It acts like a fly cutter and a brad-point bit combined.

tabs are drilling jobs common to modelers. The common twist drill has a cutting angle of 118 degrees and a chisel-edge angle of between 120 and 135 degrees (Figure 1). Actually, a drill cuts away the material being "drilled," and the two front edges (on either side of the chisel-edge center) form a cutting surface similar to a tool bit used on a metal lathe.

To make the best use of a twist drill, take the time to lay out your hole locations precisely, and center-punch them. This will prevent the drill from walking off center and provide a small indentation, which will allow the drill's chisel-edge center to start working before the cutting edges do. For large holes (1/4 inch or larger), it is best to first drill the hole with a smaller pilot drill to relieve pressure on the chisel-edge. For harder metals (like mild steel and chromoly steel), it is best to step-drill the holes using larger and larger drills to complete the job.



Spade bits are best left in the carpentry shop. They remove material quickly but without much precision. They are my very last choice for model work. And even then, only for non-critical removal of material such as hollowing out a block of balsa.

• **Wood.** Whenever possible, drill holes in wooden parts before they are glued to the model's structure. Firewalls, bulkheads and plywood servo trays are easier to handle if you lay them flat on the workbench and drill the holes. For thin materials (1/16 to 1/8 inch), I like to clamp them down to prevent the drill from grabbing and spinning the work piece.

Another way to minimize burrs is to place a scrap piece of wood under the work piece for support. By drilling slightly into the scrap piece, burrs and splinters are greatly reduced.

• **Thin plastic or fiberglass.** To drill holes in *very* thin materials (0.020 to 0.062 inch), use a contact cement to stick the material to some scrap wood. Use a Forstner bit and high rpm but a low feed. Making scale instrument panels is very easy using this method.

WHAT SIZE?

For properly sized holes, you need to know what drill size to use. Most drills have their size marked on the shank. The size can be expressed fractionally, decimally, or alphabetically. Most drill indexes have labeled drill holders to identify the drills, but you should measure the drill bit before you use it. If you are drilling a hole for a mounting bolt or tapping an engine mount, the size of the hole is critical. The best way to measure the size of a drill is with a micrometer or a Vernier caliper. The absolute minimum tool to use is a drill-and-bolt-size gauge.

CUTTING FLUIDS

For the most part, cutting fluids aren't required for the light drilling work required

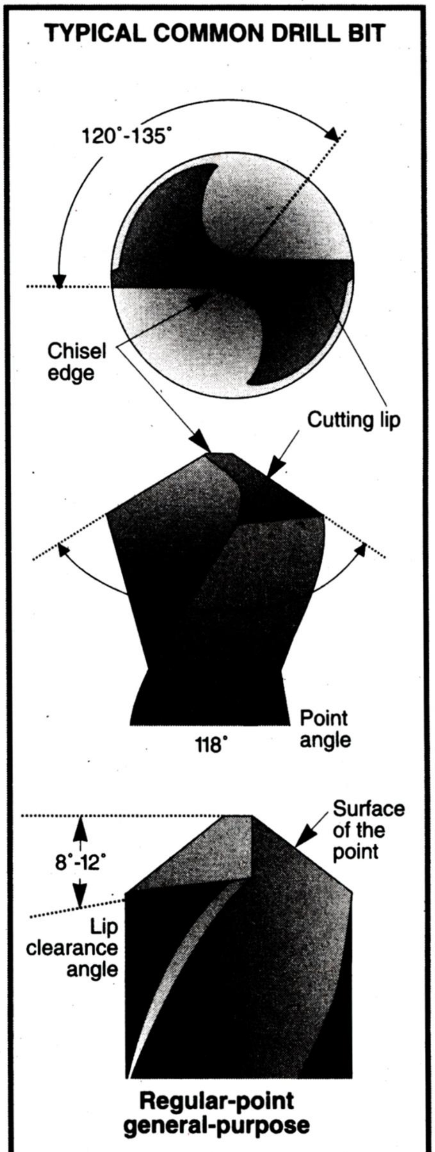
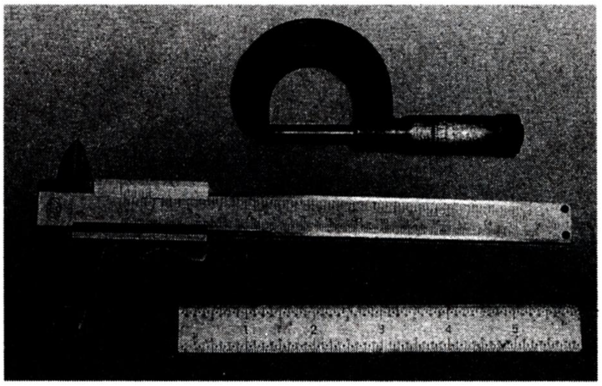


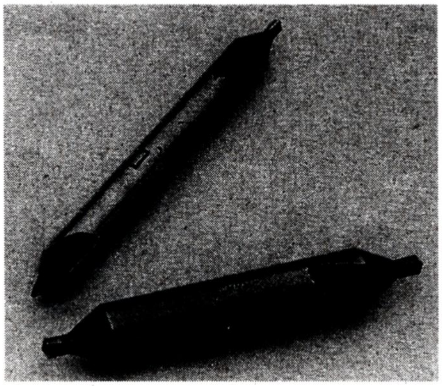
Figure 1

for model building. But if you decide to use a cutting oil with your drills, be sure to use the correct kind. For aluminum, kerosene works well as does lard paste. For steel, soluble oil and mineral oil work well. In a pinch, WD-40 can be used with aluminum and steel.

So, there you have the "hole" thing—Circular Cutting 101. Using the drill bit that best matches the material you are working with will give you much improved results. You don't have to be a machinist to achieve precise results. ■



To produce accurately drilled holes, you need to know the size of the drill you're using. From top to bottom are my choices of tools for the job. Micrometer (best), Vernier caliper and a 6-inch steel ruler. At the very least, you should have a drill-and-bolt-size gauge.

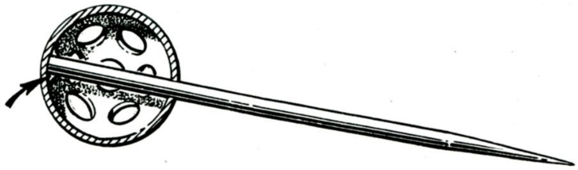


Combination drill and countersink bits (often referred to as center drills) are good for starting holes in thick metal parts. They are also used on metal lathes.

HINTS & KINKS

JIM NEWMAN

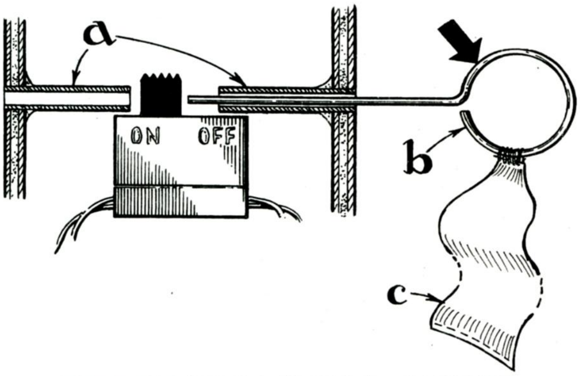
Model Airplane News will give a free one-year subscription (or one-year renewal, if you already subscribe) for each idea used in "Hints & Kinks." Send a rough sketch to Jim Newman c/o Model Airplane News, 251 Danbury Rd., Wilton, CT 06897. BE SURE YOUR NAME AND ADDRESS ARE CLEARLY PRINTED ON EACH SKETCH, PHOTO AND NOTE YOU SUBMIT. Because of the number of ideas we receive, we can't acknowledge each one, nor can we return unused material.



HIGH-PRESSURE HANDLE

Drill a small hole through an old practice golf ball, then force-fit scribers, awls, files, etc., into the hole. If you can, dribble some hot glue into the hole to secure the end of the tool. This ball fits nicely in the palm of the hand and allows a lot of pressure to be exerted.

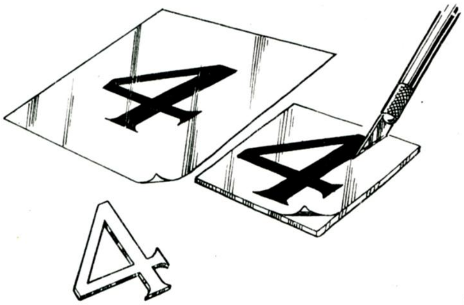
Lloyd Ressler, Gerrards Cross, Buckinghamshire, England



HIDDEN PUSH/PUSH SWITCH

Glue Nyrod guide tubes (a) through each fuselage side (aligned with the switch), then use a coat-hanger wire "key" (b) to push the switch on and off. The brightly colored flag (c) allows the key to be found if dropped in the grass.

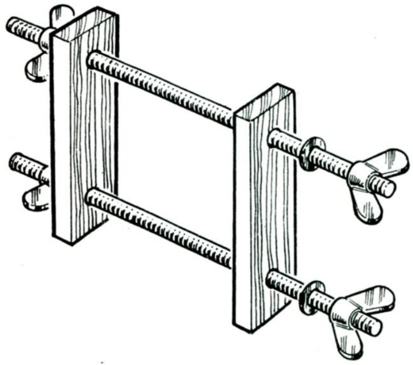
Mike Taylor, El Paso, TX



COMPUTER CHARACTER TEMPLATES

Use your computer and a simple graphics program to create numbers and letters. Using a copier, make transparent plastic prints, and use them as patterns to cut out covering film or trim film characters. By sticking them on 1/32-inch-thick (0.8mm) plastic or plywood, you can create a permanent library of templates for future use. Harden the ply edges with CA.

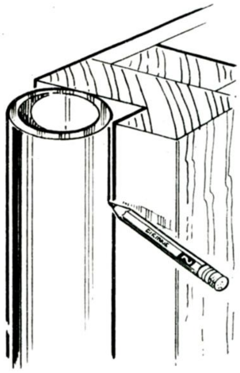
Doug Ransom, FPO AP



LARGE HANDY CLAMPS

Drill holes in two pieces of hardwood, then insert threaded rods with wingnuts and washers, as shown. This clamp is very useful when pulling two fuselage sides together, or around the house on those "Honey Do's."

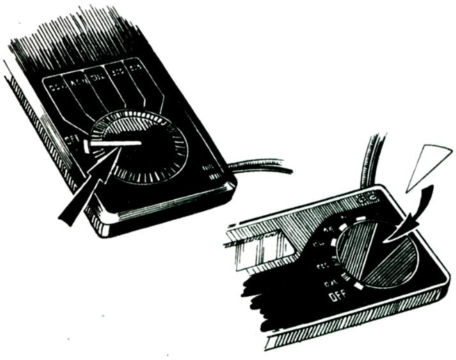
Göran Forsberg, Lulea, Sweden



ACCURATE TUBE SCRIBING

It is difficult to mark a line parallel with the center line of a dowel or a tube. Set the dowel or tube up against a door jamb or in the "V" of a piece of angle iron, then scribe away.

Bosso Giacomo, Torino, Italy



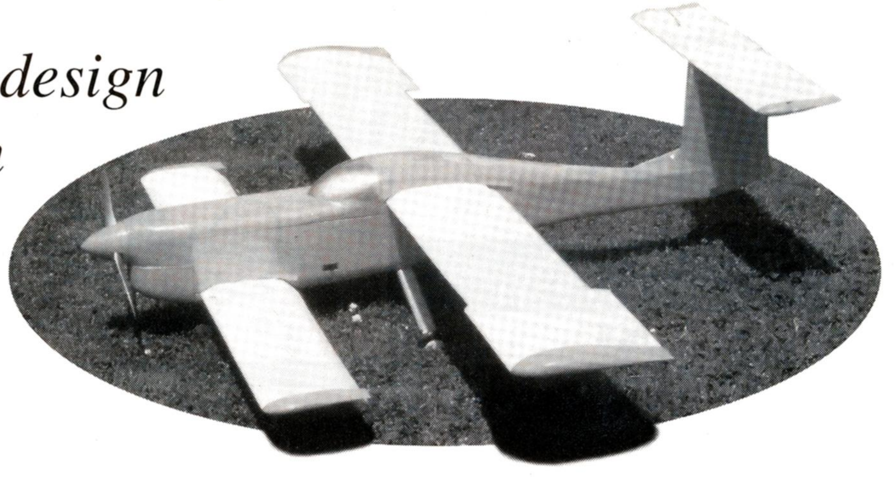
HIGHLIGHTED "OFF" SWITCHES

Radio Shack pocket meters tend to get left "on," because the faces are black and featureless. To solve this problem, either paint the pointer white, or use stick-on trim film to apply a white arrow.

Jim Collingwood, Valparaiso, IN

HOW TO

Foreplane-design application



Canards, Tandem Wings and Three-Surface Design

Part 3

by ANDY LENNON

IN LEVEL FLIGHT, at the selected cruising speed, the fore and aft wings must support the model's weight. The calculation of the weight distribution, leading to loadings for both wings, is shown in Figure. 1. The foreplane must, however, support an additional load beyond that resulting from weight alone. This results from:

- The fore and aft wing's pitching moments *always* being nose-down or negative.
- Propeller thrust loading.
- Drag moments of both fore and aft wings.

Explanation and evaluation follows:

Pitching moments are explained in "Airfoil Selection," Parts 1 and 2 and Formula 10 in Part 2 permits the calculation of these moments in inch-ounces. Symmetrical airfoils have no pitching moment.

If the propeller thrust is above an imaginary horizontal line drawn through the CG, a nose-down (or negative) moment results. Below that horizontal line, thrust produces a nose-up moment that reduces the foreplane load. If the CG is on the thrust line, there is no thrust loading. The thrust, in ounces, required to propel the model at the design's level flight speed is difficult to evaluate; an estimate would be 40 percent of the model's gross weight. For a weight of 100 ounces, thrust would be 40 ounces.

Figure 2 provides formulas for calculating the wing pitch and thrust-related foreplane loads in ounces. Fore- and aft-plane drag moments consist of the total of profile and induced drags, in ounces, multiplied by the distance, in inches, the wing's 1/4 MAC is above or below the CG. If it's above the CG, the moment is nose-up, or positive, and below it, it is nose-down, or negative (see Formulas 5 and 9 of Part 2 of "Airfoil Selection," June 1992).

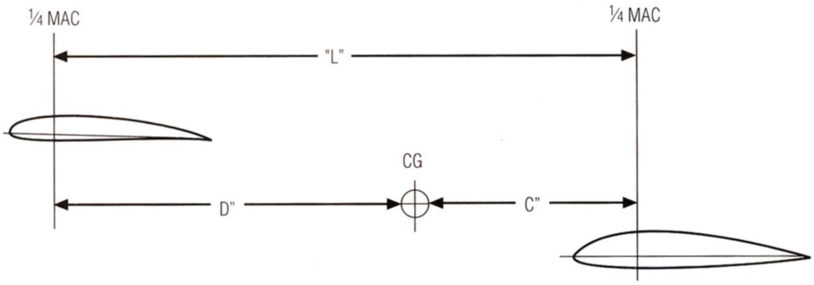
Figures 3A and 3B provide simple formulas for establishing the effect of drag moments on the foreplane load in ounces. The total foreplane load is composed of its share of the model's weight plus the net sum of the moment source loads, pitching moments, thrust moments and drag moments (in ounces). *Both thrust and drag loads may be positive or negative; take care to identify each so that the net value will be correct.*

LIFT COEFFICIENTS

Having determined the wings' areas in square inches and their loadings in ounces, the level-flight design speed estimated (see Formula 7 in "Airfoil Selection" Part 2) permits calculation of the lift coefficients required for each wing's airfoil. Applying "Special Procedures" A and B will determine the angles of attack to provide those lift coefficients.

As discussed in Part 1 of this series (November '95, under subhead, "Downwash and Tip Vortices"), decide which of the procedures will be used to compensate for the reduction in angle of attack caused by the downwash affecting the aft wing behind the foreplane.

The foregoing provides conditions for level flight at the design speed; any variations from that speed will require the same trim adjustments as for a conventional model.



$$\text{Foreplane loading} = \frac{\text{Gross Weight x C}}{\text{L}} \qquad \text{Aft plane loading} = \frac{\text{Gross Weight x D}}{\text{L}}$$

Figure 1. Calculation of wing loadings due to weight only.

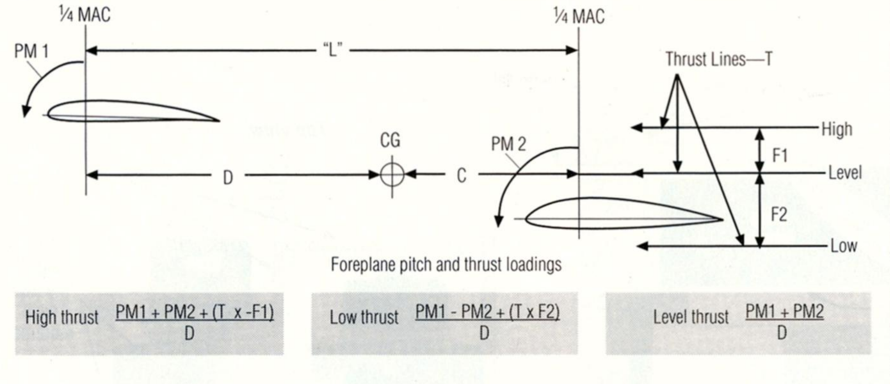


Figure 2. Additional foreplane loading from wing pitching moments and thrust.

• **Stability test.** In Part 1 of this series, two points of critical importance for longitudinal stability were discussed.

1. The foreplane must stall first.
2. The aft plane must hit zero-lift first.

Now that the angles of attack of both wings have been calculated, it is time for this test:

Using "Special Procedure" C in "Airfoil Selection," Part 2, determine the stalling angle for each wing and the zero-lift angles from the airfoils' curves at the landing speed Reynolds numbers.

Compare the spread from angle of attack to the stalling angle, but *before* estimating the downwash compensation. Raising the foreplane's lift by lowering its flaps will bring it to its stall attitude; the increased lift produced by both the foreplane and its flap will increase the angle of downwash, increasing the aft wing's stall margin, but only for that portion of the aft wing in the foreplane's downwash; that part out of downwash isn't affected. If your foreplane's calculated angle of attack is 3 degrees and it stalls at 12 degrees, there's a spread of 9 degrees. With an aft wing at 1 degrees, stalling at 14 degrees, the spread is 13 degrees so that the foreplane stalls first.

Similarly compare the spread from zero-lift angles of attack to your calculated angles for both wings. That of the foreplane should be substantially higher than that of the aft plane. As the foreplane moves toward zero lift, its downwash angle is reduced, increasing the aft wing's lift in the downwashed area and increasing the spread from zero lift to actual angle of attack.

The Eppler E214 has a zero-lift angle of -4.75 degrees ; if set at 3 degrees, as above, the spread is +3 degrees to -4.75 degrees, or 7.75 degrees. The Eppler E197 has a zero-lift angle of minus 2 degrees. Set at +1 degree, the spread is +1 degree to -2 degrees or 3 degrees, leaving a healthy margin of 4.75 degrees.

THREE-SURFACE AIRPLANE

This type presents more options than either canard or tandem wing configurations as regards the lift distribution between all three surfaces.

1. The canard and main wing provide all the lift needed. The horizontal tail provides no lift at the selected speed, but its elevators control pitch and trim.
2. Have the canard provide most of its share of the needed lift with the horizontal tail providing a compensating download.
3. Have all three surfaces share the lift. This author's choice would be "1" above—canard and main wing doing all the lifting. Calculation of wing loads would be that for canards and tandem wings described previously.

• **Unique behavior of the three-surface configuration.** Flight tests of the Wild Goose (Figure 8) disclosed unique behavior that relates directly to the three options outlined above. Option 1 had been selected for this model. During its design, the airplane's wing loadings were calculated to be 46 ounces per square foot for the foreplane and 22 ounces per square foot for the aft plane in level flight at 60mph.

The foreplane's loading consisted of 18 ounces per square foot for its share of the model's weight, plus 28 ounces per square foot due to the nose-down load from the airfoils' pitching and the airplane's thrust and drag moments. This high foreplane loading was of concern; but slotted flaps on both fore and aft wings were calculated to bring takeoff and landing speeds to reasonable levels.

During test flights, two unusual characteristics became very evident:

• Elevator pitch control was *very* sensitive.
• Landing speed, *flaps-up,* was more in keeping with the aft wing's lower loading and comparatively slow—an estimated 25mph.

The explanation of this surprising behavior was reasoned as follows: a conventional, tail-last airplane with its CG well ahead of its wing's center of lift requires a tail-down load (up-elevator) for level flight. The CG of the three-surface design is well ahead of the aft wing's center of lift, and in level flight, the foreplane's lift provides the balancing upward lift. Up-elevator downloads the tail and unloads the foreplane, reducing its wing loading substantially. The foreplane's *surplus* lift is then adding to the up-elevator action, causing the elevator sensitivity.

This results in a very beneficial reduction in landing and takeoff speeds, both flaps-up and flaps-down. This unique behavior has an

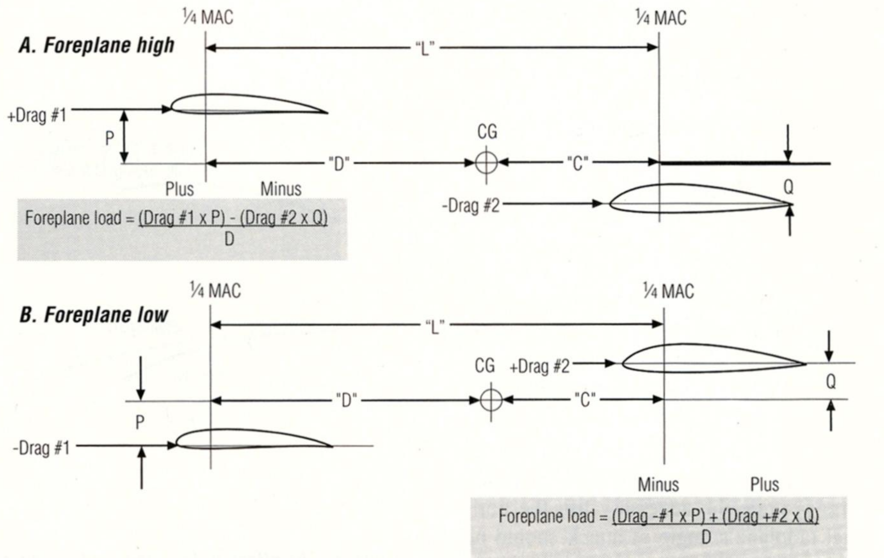


Figure 3. Foreplane loading from fore and aft wing drag moments.

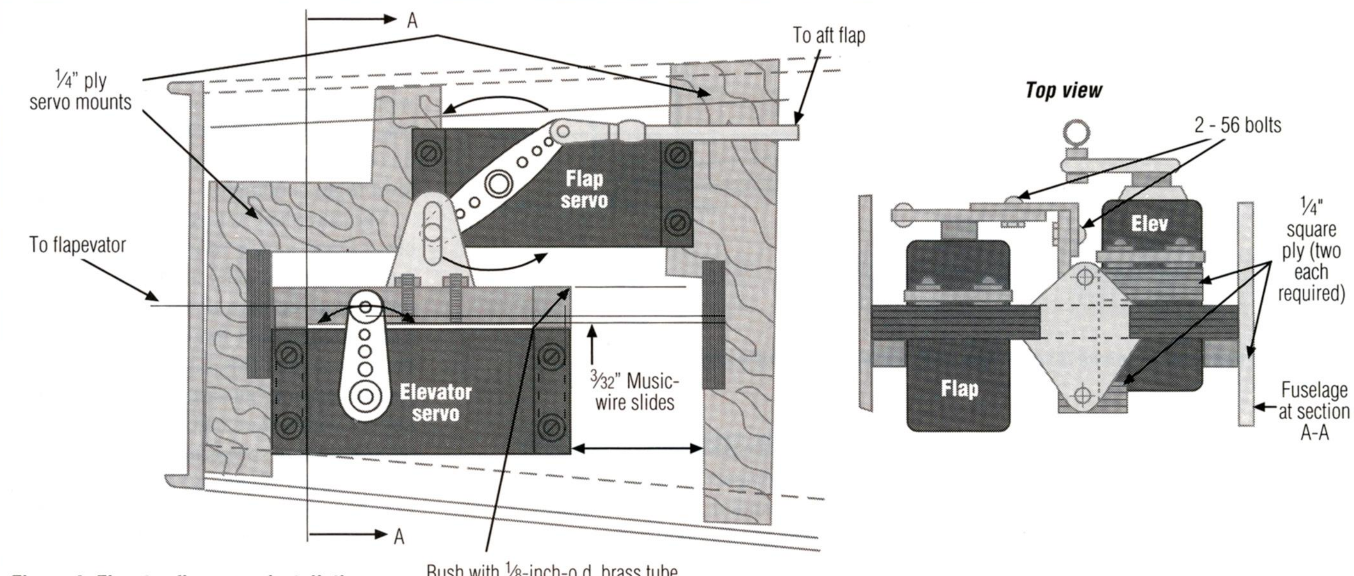


Figure 4. Elevator-flap servo installation.

impact on the three options listed above.

Option 1 is considered above; option 2 would reduce the foreplane's wing loading, its angle of attack, its lift coefficient and its downwash angle. The aft wing's loading would increase, requiring an increase in its angle of attack. This would bring both wings' airfoils closer to dangerously unstable conditions, as explained in Part 1 (November '95) and Figures 7 and 8, but it could reduce elevator sensitivity.

Option 3—having the horizontal tail lift upward—would add to the foreplane's loading and would result in even greater elevator sensitivity.

In this author's opinion, option 1 is best. Elevator sensitivity may be overcome by use of the elevator's *low* dual rate, or by reducing the elevator's area to 20 or 25 percent of the horizontal tail's area instead of the Wild Goose's 40 percent.

• **Longitudinal control methods.** The dominant pitch control for canards is a slotted flap on the canard. Another method is a flap on the foreplane and simultaneous up or down action of ailerons on the aft wing. The major method for tandem wings is a plain flap of full or partial span on the foreplane. The horizontal tailplane's elevators are the sole pitch control for three-surface designs. "Horizontal Tail Design," Parts 1 and 2 (November and December '93) give design guides.

If option 1 is chosen and fore and main planes provide the necessary lift, the horizontal tailplane's angle of attack should be zero degrees to the downwash from the main wing. That downwash angle is based on the level-flight lift coefficient generated by the main wing, which is, itself, in the foreplane's downwash! "Horizontal Tail Incidence" (September '95) provides charts for estimating downwash.

• **Directional control.** "Vertical Tail Design" (January '94 issue) provides the basis for obtaining good directional control. For tandem-wing and three-surface models, the moment arm from CG to MAC of the vertical tail surfaces is large enough to permit reasonably sized surfaces.

Canards, particularly those with small foreplanes and pusher engines, do not have adequate moment arms. Recourse is:

• Larger vertical surfaces
• Booms or fuselage extensions supporting smaller surfaces.
• Aft wing sweepback and wingtip vertical surfaces.

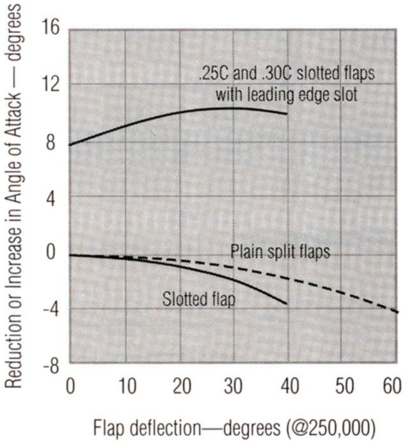


Figure 5. The effect of flaps and leading-edge slots on the angle of maximum lift.

FLAPS

Flaps were mentioned in Part 1, and their limitations were briefly outlined. Since both fore and main wings share the provision of lift, the additional lift provided on flap extension *must not upset* the lift distribution

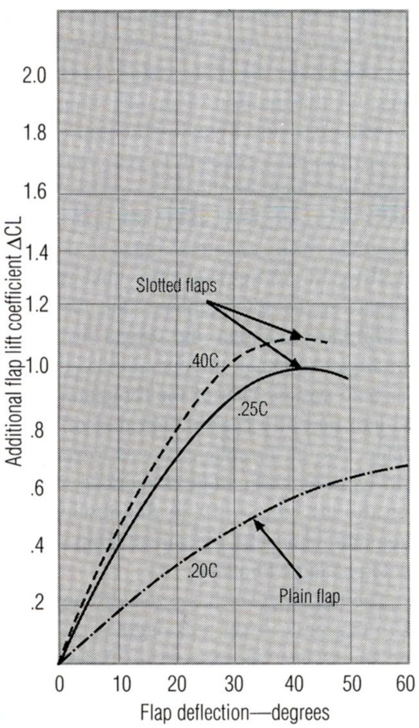


Figure 6. Additional flap lift coefficient example .40 slotted flap depressed 20 degrees provides Δ CL of 0.80 to lift of basic airfoil section.

between the wings. Too much lift from either wing would result in dangerous nose-up or nose-down pitch. Both sets of flaps must be lowered simultaneously for the same reason.

Both of this author's canard designs—the Swan and the Canada Goose—had slotted flaps on both wings. The foreplane flaps also provided pitch control as "flapevators." On both models, one servo actuated the foreplane slotted flap for pitch control, but it was mounted on a slide that permitted it to move backward under control of a second fixed servo (Figure 4), lowering both the fore and aft plane flaps simultaneously—foreplane flaps to 20 degrees deflection and aft-plane flaps to such deflection as balanced the increased foreplane lift.

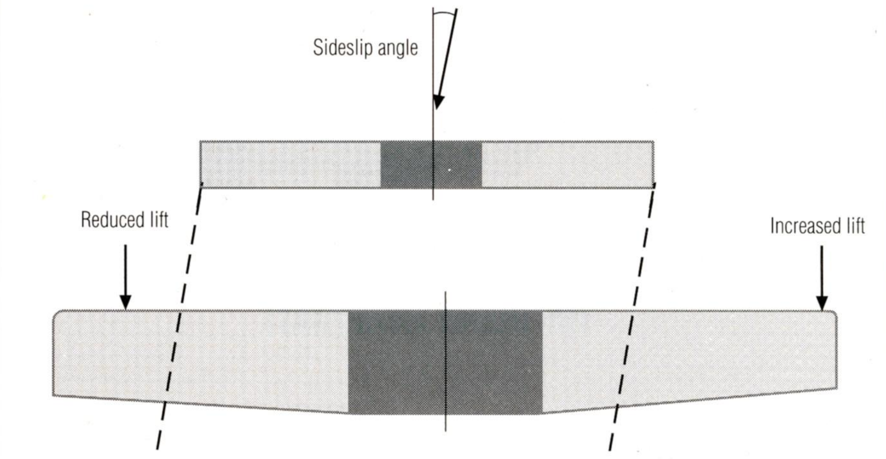


Figure 7. The asymmetric canard downwash due to sideslip.

Slotted flaps provide their maximum additional lift at 40 degrees deflection so that the foreplane flap, still under control of the first servo, may move up to neutral or down to the full 40-degree deflection from its 20-degree position for pitch control. Deflecting the foreplane flap results in a substantial increase in downwash on the aft wing, reducing its lift and that of the aft flaps in the area "shadowed" by the foreplane's downwash.

Any attempt to calculate the aft flap deflection angle to balance the front flap's 20-degree deflection would have been very complex. Instead, cautious flight tests were performed, progressively increasing aft flap deflection on each flight, until balance was achieved. Bear in mind that the foreplane flap could be raised or lowered to correct any minor imbalance, and if the imbalance was major, retracting both sets of flaps

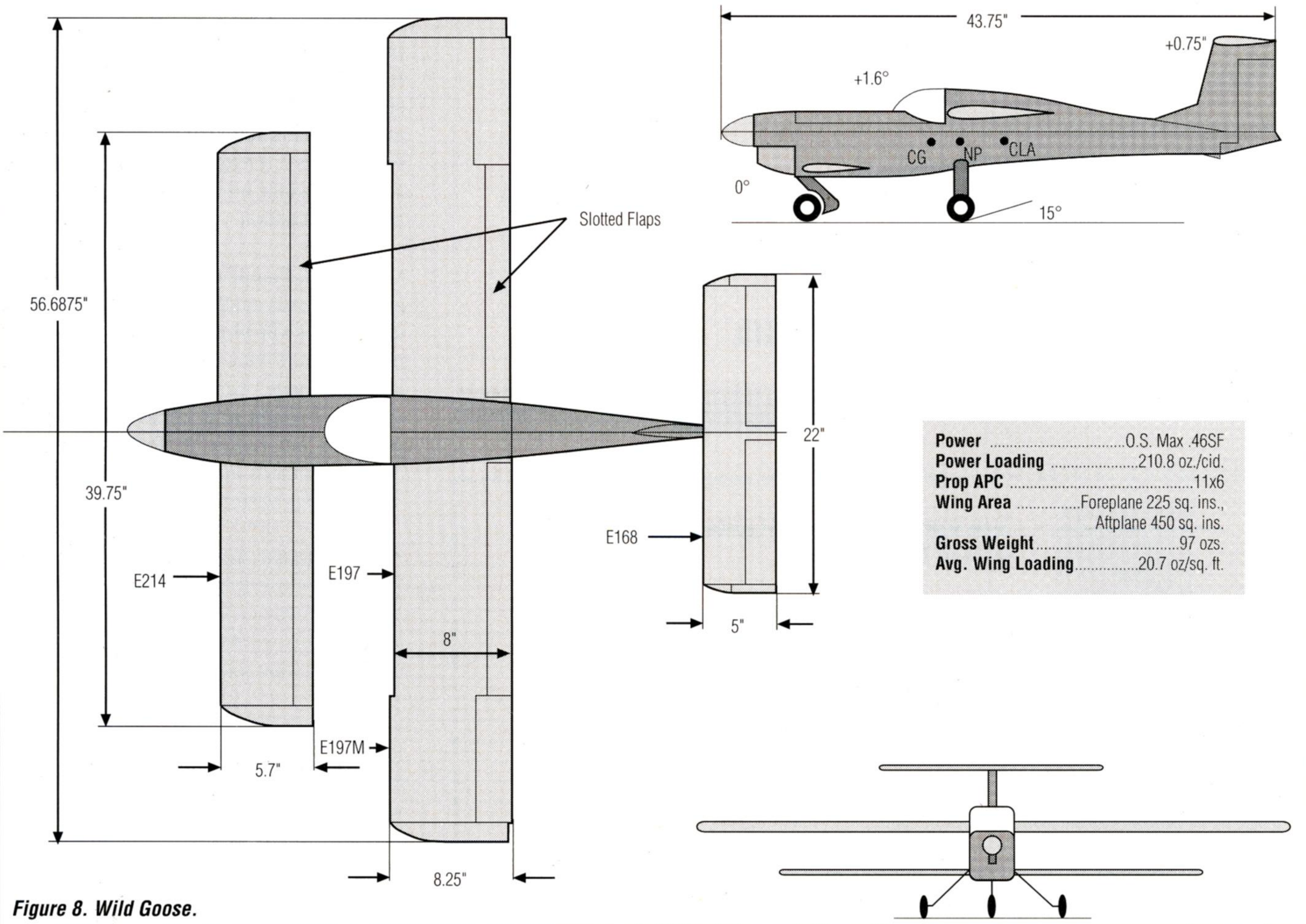


Figure 8. Wild Goose.

CANARDS, TANDEM WINGS AND THREE-SURFACE DESIGN, PART 3

would restore the model to normal, flaps-up, flight. This worked; the Swan's aft wing slotted flaps, of partial wingspan, were extended to 35 degrees in balancing the foreplane's full-span slotted flaps deployed to 20 degrees.

In flight, lowering the flaps caused the model to "levitate"—at much slower speed, but with no up or down pitch—and the foreplane flap continued its function as elevator under control of the first servo. Almost full foreflap deflection was needed, in ground effect, to raise the nose for a gentle landing.

Flap deflection reduces the stalling angles of both fore and aft wings and greatly increases the foreplane's angle of zero lift (Figure 5). For three-surface designs, the same comments regarding balanced flap lift and simultaneous extension of both sets of flaps apply. However, the foreplane flap serves only as a flap; pitch control is effected by the tailplane's elevators so that the foreflap may be deflected 40 degrees.

Slotted flaps on a tandem-wing design would present the same problems as canard flaps. Slotted flaps with chords of up to 40 percent of the wing's chord may be used on foreplanes, as shown in Figure 6. Use of such wide-chord flaps on the aft plane is not recommended. "Design for Flaps," Parts 1 and 2 (October and November '91) provide insight into flap design, construction and actuation.

• **Dihedral.** Foreplane downwash impacting asymmetrically on the aft wing in a side slip creates a powerful dihedral effect when the plane yaws (Figure 7). John Roncz's three-surface "Eagle" has no dihedral; its wings are "flat." Flight tests confirmed that dihedral was not required. The same would apply to canards and, to a lesser extent, to tandem-wing design

• **Landing-gear design.** The two-part series "Landing-Gear Design" (March and June '94 issues) covers this subject. The stalling characteristics of the foreplane govern landing-gear design, for all three versions.

• **Structural design.** "Stressed-Skin Design," Parts 1 and 2, September and October '92, apply to all three types of front-wing-first airplanes. Use of this type of structure would simplify weight estimating and provide optimum weight-to-strength ratios.

Good luck, and happy landings. ■

FIELD & BENCH REVIEW

LITE MACHINES

Heli-100

Miniature chopper for the novice

by DAVID MILES

THE LMH 100 is a perfect combination of engineering and simplicity and sells for a fraction of the cost of other, more complex helicopters. This nimble, fixed-pitch helicopter can be flown with any radio coupled to four microservos, and it includes a patented gyro for tail stabilization. This machine can get a beginner into the air for less than $200, and it performs well enough to teach an experienced pilot a few new tricks.

THE KIT

The quality of this kit is impressive. The plywood parts are precisely cut, and the parts fit is excellent. All other parts are either machined metal or injection-molded plastic. The machined heat-sink head for the Cox TD .051 is particularly interesting. The plastic parts have been molded out of various materials chosen for their specific function. High-stress parts have been molded out of polycarbonate, which is virtually bulletproof; after many hard landings (mostly caused by a finicky .051 that wasn't fully broken in), no damage was done to the mechanics.

At first glance, the LMH 100 appears to be a major undertaking. But construction is actually quite simple and straightforward. As with all helicopters, it is very important to follow the directions to a T. Lite Machines* has left nothing to chance.

PHOTOS BY WALTER SIDAS

CONSTRUCTION

Construction begins with the crutch—the backbone of the LMH 100. All the major mechanics are connected to this structure. This is the only part that is made of plywood, so it must be protected. The first step is to add the fuselage stiffeners to the crutch. They double as servo mounts, so be sure to have your servos available for fitting. Then drill mounting holes and test-mount your servos.

Next, add the firewall. To make it easier to align the firewall with the fuselage, fit toothpicks through the holes that have been drilled in the main frame. Then add the floor, front and rear landing-gear brackets, triangle-stock gussets and canopy-mounting brackets. During these steps, I used thick CA.

The crutch was then ready to be fuelproofed. To protect the plywood parts, I applied three liberal coats of Pactra* Aerogloss clear dope. As suggested by Lite Machines, add a dark color over the clear dope to keep the machine looking cleaner.

• **Canopy.** The canopy is a two-piece, vacuum-formed plastic shell with two mounting doublers. It is very light and easy to assemble. After the parts had been carefully cut

FLIGHT PERFORMANCE

• Takeoff and landing

The LMH 100 is extremely light, so it's eager to fly. I found that slowly increasing the throttle allowed the helicopter to build up rotor speed and lift gently into the air. Once the heli is airborne, it will continue to rise rapidly if the throttle isn't eased back.

Landing the LMH is not difficult, but you must be aware of rotor-head speed. With a fixed-pitch helicopter, the rotor-head speed must be reduced to decrease lift. Unfortunately, as rotor speed decreases, so does the controllability of the helicopter, and control inputs respond more slowly and require larger corrections. I found that slow, steady descents were the safest approaches to landing, using quick bursts of power to check the descent rate. The helicopter does not respond to throttle like a collective-pitch helicopter, so descent and landing will take a little getting used to for experienced collective-pitch chopper pilots.

• Hovering

Hovering the LMH 100 is quite comfortable. Cyclic and tail-rotor controls are smooth but powerful enough to keep the helicopter virtually stationary. I had a bit of difficulty maintaining a fixed altitude because I don't have much experience flying fixed-pitch choppers. But as I practiced, I learned to anticipate the throttle command required to maintain altitude, and I initiated the command before the need for the change was apparent. Be careful not to over-control the throttle stick; I found that short, quick corrections in throttle, returning to my approximate hovering stick position, worked best.

• Forward flight

Forward flight is a blast.This heli performs every maneuver that a beginner needs to learn. I particularly enjoyed practicing ground work that I would not want to try with my larger, more expensive choppers. When the LMH 100 hits the ground, it bounces but does not break.

When you take it up in the air, there are a few things to consider. The helicopter flies well in fast forward flight, but it takes some getting used to. In tight turns, it is very important to keep the tail coordinated and the rotor speed high. If you let the tail drop, the helicopter will climb quickly, leading to a sloppy turn. If the rotor speed is dissipated during the turn, the helicopter won't climb as before, and control response will be poor. Finally, as your forward flight speed increases, you will require more right tail-rotor input to compensate for translation lift's positive effect on the tail rotor's performance. Easing into forward flight and working on the turn entries while slowly increasing the forward flight speed worked best.

• Advanced flight and aerobatics

Though the LMH 100 is a nimble performer, I have not performed any aerobatics other than stall turns. When I become more comfortable with my machine, I may try a loop at high altitude. But I would not recommend this, because I'm not sure that the heli would recover. Good luck.

out, I added the doublers and glued the canopy pieces together using Pacer's* Zap-a-Dap-a-Goo. Use trim sheets to decorate the canopy; do not paint it. Trim sheet templates are included with the instructions.

• **Main rotor.** The next step was to assemble the main- and sub-rotor assembly. The rotor head was designed to maximize performance using a sub-rotor rather than the more typical flybar and paddles. The sub-rotor performs the same duties as a flybar, but the blades (paddles) have a positive angle of attack. Therefore, the sub-rotor not only provides the initial control input to the rotor head, but it is also a lifting surface. This angle of attack also minimizes the efficiency loss created by the downwash of the main rotor blades.

I followed the illustrated directions for the assembly of the main rotor head and found them easy to follow and understand. Critical steps and areas that require particular attention are highlighted to expedite the building process. The "bolded" warnings saved time and outlined problem areas. I finished the rotor head and installed all the control rods in approximately 1 hour. Then I temporarily mounted the rotor head on the main shaft and crutch to balance the head. The process is straightforward and well-explained in the manual.

• **Swashplate.** The swashplate consists of an injection-molded base with a machined-aluminum inner and outer race and steel bearings. Assembly is straightforward and provides slop-free rotor-head control. Following assembly, install the swashplate on the main shaft and connect the remaining linkages to the crutch.

• **Arlton gyro.** This mechanical gyro replaces the more traditional electronic gyros used on all current full-size and model helicopters. It stabilizes the tail rotor on the helicopter. Without it, the model would be virtually uncontrollable.

First, use various setscrews and press-fit pins to assemble the push/pullrod, spider assembly, gyro pivot mount and spindle. Next, add the drive bar and paddles. Pay attention to all the moving parts to avoid any potential binding.

• **Tail boom.** This aluminum tube houses a wire drive shaft that provides power for the tail rotor. First, mount the drive-shaft bushings, front tail-mounting bracket, pinion gear, drive shaft and bevel gear. Next, assemble the tail-rotor gearbox, and install it on the tail boom. It is critical that the bearings be properly fitted and the bevel gears be greased and meshed correctly. The tail-rotor hub and bearing collar are then locked on with setscrews.

Next, attach the push/pullrod, tail-rotor bellcrank and the vertical fin to the tail-rotor gearbox and the tail-rotor blades and gyro assembly to the tail-rotor hub and push/pullrod. It is critical that the gyro pivot mount be attached properly, or the gyro will destabilize the tail.

• **Engine.** The LMH 100 came with a Cox

SPECIFICATIONS

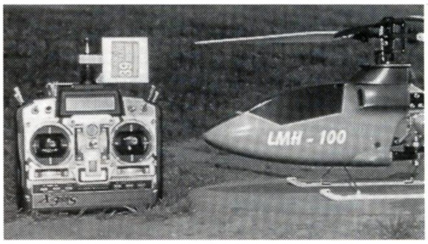
Model name: LMH 100
Type: entry-level helicopter
Manufacturer: Lite Machines Corp.
List price: $199 (includes gyro)
Rotor span: main rotor—24 in.; sub-rotor—9.5 in.
Airfoil: tapered rotor blades with under-camber and washout
Weight: 27 oz.
Pitch: adjustable from 4 to 6 degrees
Engine: Cox TD .051
No. of channels: 4 (aileron, elevator, tail rotor and throttle microservos)

Features: high-quality components and engineering, a detailed and illustrated assembly manual and a complete operating guide that introduces the new pilot to the hows and whys of helicopter flight, virtually guaranteeing success. Rotor blades are made of semi-flexible, injection-molded plastic and can be bent into a 90-degree angle in a crash.

Hits
- Lightweight construction.
- Durable, easy and inexpensive to maintain.
- Kit includes extra nuts and bolts and all the Allen wrenches required for assembly.

Misses
- It's difficult to keep the .051 running consistently well while breaking it in.

TD .051. Lite Machines discourages the use of other engines, because the helicopter was specifically designed for the TD series of .049 and .051 engines. Once it had been "dialed in," the TD .051 provided plenty of power and functioned reliably. Engine power is transferred through a machined-aluminum clutch in a plastic clutch bell. Lubrication is provided by the castor oil



A JR 3885 radio controls the author's LMH-100.

ejected from the engine. The clutch assembly is attached to the engine with a clutch shaft designed specifically for the TD .051 (.049). After installing the clutch assembly, install the machined-aluminum starter cone on the clutch shaft. The final step is to add the throttle sleeve (available from Ace R/C*), Glow-Bee plug and heat-sink head.

• **Final assembly** included mounting the landing gear, fuel tank, tail-boom assembly and engine and making final adjustments to the gear mesh. These steps require critical attention. Next, mount the radio equipment. My helicopter needed only minor corrections to the pushrods during the test flights.

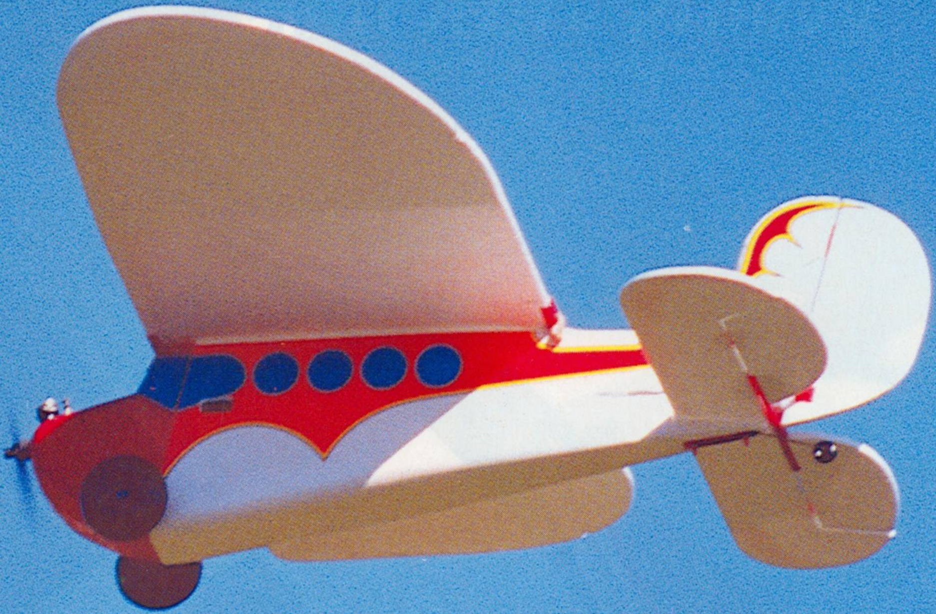
FIRST FLIGHT

Fortunately, I had the opportunity to talk with Paul Arlton of Lite Machines, who offered some excellent advice and told me briefly about his company's philosophy. The folks at LMC are dedicated to continuous improvement, running short quantities of kits at a time and listening to suggestions and comments from their customers. Paul also explained the reasons for the difficulties I had flying my helicopter. The LMH 100 was designed to fly at fields that are as high as 6,000 feet above sea level (MSL). My favorite flying field is only about 500 feet MSL, so the helicopter was much more efficient at the lower elevation and really wanted to climb. Paul suggested that I add weight to my machine to counteract the increase in efficiency; this was the cure. I added approximately 2 ounces of lead to the CG of my helicopter and reset the rotor blades to 5 degrees of pitch. The performance was much better.

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

FIELD & BENCH REVIEW

a simple design for beginners



SPECIFICATIONS

Model name: Lazy Bee
Manufacturer: Cox
Type: R/C trainer
Wingspan: 39 in.
Length: 32.75 in.
Wing area: 510 sq. in.
Airfoil: under-cambered
Weight: 25 oz.
Radio supplied: Cox 2-channel
Engine supplied: Cox .049
Prop supplied: Cox 6x3
List price: $288.78 (includes engine and radio)
Features: no complicated building; takes off from ground; exciting to fly; big control surfaces for quick responses; hands-off recovery; a large fuel tank for longer flights; clear instruction manual.

Hits
- Pre-constructed of foam.
- Short building time (two to three hours).
- Great flier; very stable.
- Great for beginners.
- Reliable radio.

Misses
- Takes some time to get the engin to run, but after it has been run, it's easy to start again.

by STAFF

COX PRODUCTS *Lazy* BEE

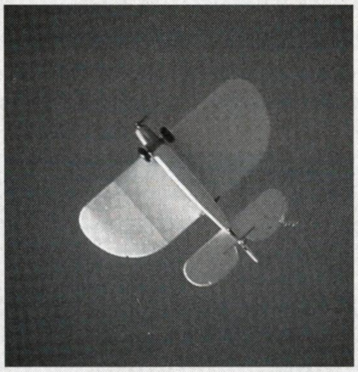
NOTHING KEEPS novices' interest piqued like experiencing the excitement of an R/C flight first-hand. The sooner that happens, the faster they're "hooked" by the thrill of it all. Some, however, think that beginners must "pay their dues" and not have things too easy. But we want newcomers to succeed quickly so that their enthusiasm for and interest in the hobby grow rapidly.

The Cox* Lazy Bee will let a beginner succeed and keep him interested. It can be assembled in a few hours, can take off from a smooth surface or "bee" hand-launched, and because it's extremely docile, it can be flown in a small field.

PHOTOS BY WALTER SIDAS

FLIGHT PERFORMANCE

The Lazy Bee is very easy to fly. It can be flown in moderate wind, but beginners should stick to calm conditions. After gaining some flight experience, you can attempt to fly on a windy day. We flew the Bee in a variety of conditions, and we can verify that it can take being knocked around by a light wind.



Takeoff and landing

On a calm day or a day when the wind is blowing lightly down the runway, you can attempt takeoffs from a paved road or strip. At a grass field, we recommend hand-launching. With the Cox .049 tuned to maximum rpm, the Lazy Bee climbs out without a problem—by no means a steeply angled climb-out, so you won't find yourself fiddling with the trim lever to control the angle. On windy days, be sure you gain some altitude before you make your crosswind turn. If a gust catches the wing, it could flip your plane up on its side, and if the Bee was too low to the ground, it could put an end to your flying that day. Landing is very simple: when the engine quits, feed in some up-trim to achieve the best glide angle, and guide the plane with the rudder. When it's lined up with the field, allow it to glide in and just flare (pull back on the elevator stick a little) it slightly for a soft touchdown.

High-speed performance

Well, you can guess that this plane isn't a powerhouse, but it can move fairly fast when tuned and trimmed to perfection. Besides flying the Bee, we had the opportunity to fly in formation with it using a Hobby Lobby* Telemaster 70. With the Telemaster set up for slow flight, the Bee left it in the dust. The guys at the field thought this was quite funny. The only way to get the Lazy Bee to stall under full power is to pull way back on the elevator stick. When the Bee stalls, release the stick pressure, and it starts to fly itself again.

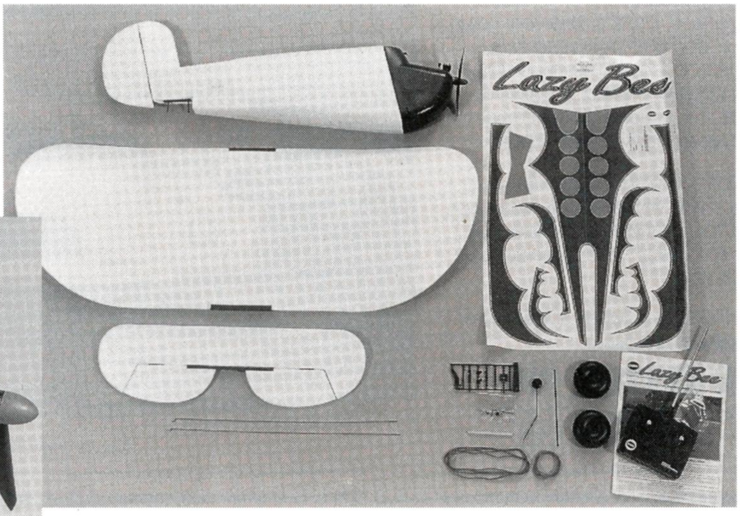
Low-speed performance

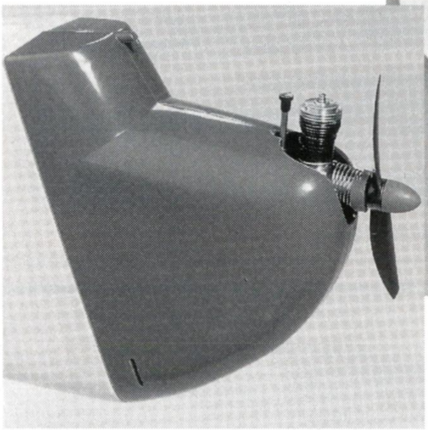
Depending on your interpretation of "low speed," you might have to wait for the engine to quit before you can fit the Bee into this category. Low speed consists of a nice flat glide (with proper up-trim added) and, again, if you stall it, just release the stick and let it start flying again. There are no surprises here; it is an absolute joy to take the Bee up to a high altitude and thermal it when the engine stops. One day, we were able to glide for 10 minutes after the engine had quit.

Aerobatics

With its surfaces set for maximum deflection, the Bee can do many types of aerobatics. We did barrel rolls, loops, Immelmanns, split-S's, stall turns, Cuban-8s, spins and other delicate maneuvers. It takes a little trial and error to master these stunts, so we recommend that you keep an eye on the wing's structural integrity and practice with some altitude.

Right: the Bee out of the hive. Assembly should take only two to three hours at the most. Below: the Cox .049 is pre-mounted on a firewall that's sandwiched between the two plastic front pieces.

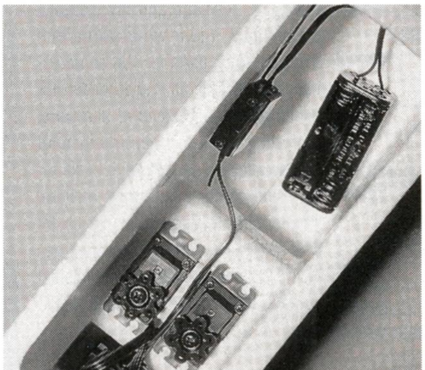




CONSTRUCTION

The Lazy Bee is an all-foam-and-bullet-proof-plastic, 2-channel version of Clancy Aviation's Lazy Bee and is produced under license from them. It's also as close to being ready to fly as you can get.

Everything has been built; the radio and the .049 engine have been installed; and all you have to do is install the horizontal stab and tail wheel, hook up the control rods, attach the control horns, install the sprung landing gear and the dowel, put in the batteries, stick on the decals and strap on the wing—and fly. No finishing or gluing is required. The instruction manual contains great pictures and text that make assembly quite simple. The second page of the manual contains a list of tools and a parts list. It is the shortest list of required tools that we've seen: small and medium Phillips-head screwdrivers, needle-nose pliers and a 5⁄16-inch open-end wrench or nut driver. Most of us have these tools hanging around.



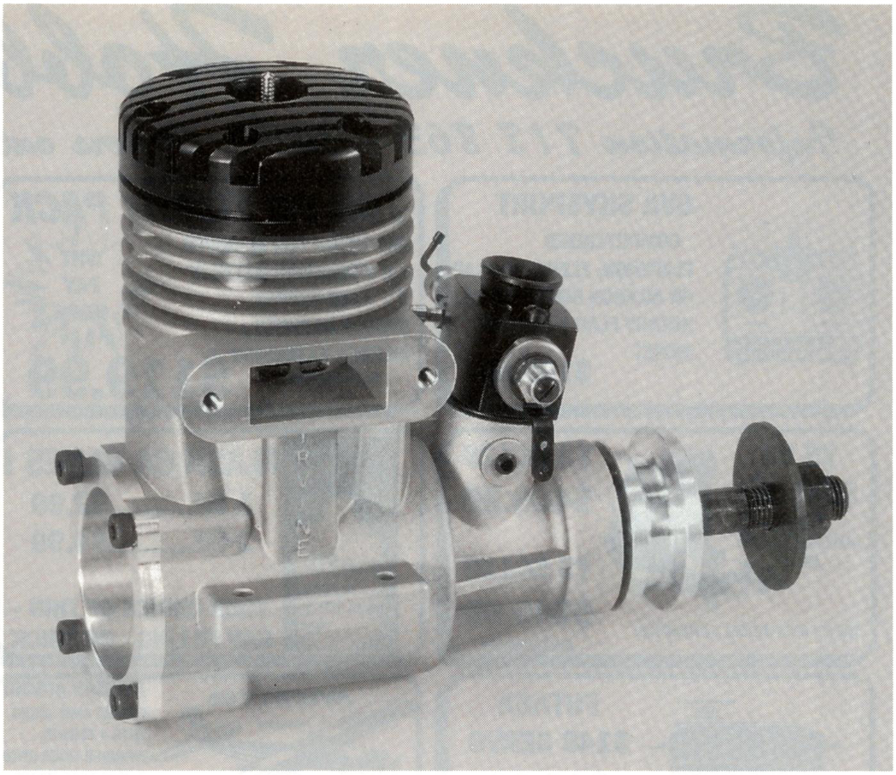
The radio is well-protected by the Styrofoam fuselage halves. The battery pack (four double-A's) should be wrapped in foam and positioned where needed for balancing.

Beginners should pay particular attention to step 15; it deals with being at the field and flying the Bee. If you need to repair the Bee, don't use honey; use 5-minute epoxy; CA will melt the foam. (Don't forget to balance the Bee!) Total construction time ranges from two to three hours—not bad!

The Lazy Bee is a good performer and, for the beginners who aren't builders and don't have large budgets, it's the answer to their prayers. Build it and fly it according to the instructions, and you'll have many hours of fun. Enjoy!

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

ENGINE REVIEW



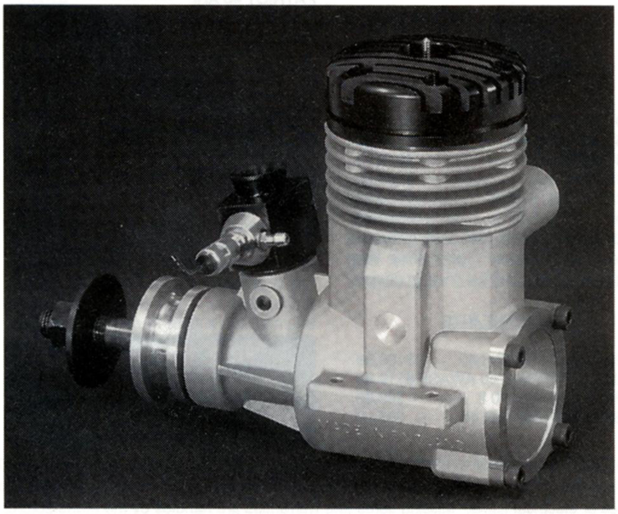
IRVINE'S* NEW ¼-scale 25cc 2-stroke single-cylinder sport engine is a bored-out version of their earlier 120 (20cc) sport engine. The original transfer and boost passages have been left untouched; the crankcase has been enlarged to accept a bigger-bore liner, and this reduces both the height and the width of the transfer passages. This means that at high rpm, the 150's operation is restricted, but at lower rpm, torque is good, so large props can be used, and sound is at a level that almost guarantees flying site retention.

Irvine 150 2-Stroke

1/4-scale 25cc powerhouse

by MIKE BILLINTON

A look at previous engine-test results suggests one fact concerning the modern 2-stroke: if allowed reasonable breathing, it can deliver good torque over a very large rpm band. It looks as if Irvine has decided to restrict high-rpm operation by restricting breathing and, thus, to restrict this engine's potential for noise. The Irvine 150 functions most effectively in the lower rpm area. The thinking behind its design seems to be: if the high rpm provide only a small gain, there will be little temptation to use them. It's very interesting that the Irvine 150's power production is very similar to that of the Saito 150 4-stroke's rpm range and power-curve placement. As many modelers now know, the model 4-stroke is a relatively restricted-rpm machine.



Though it's more expensive to produce, the one-piece crankcase provides better overall rigidity than a two-piece crankcase. The reliable, two-needle carburetor has a helical groove in the throttle barrel for a more accurate mid and low-end fuel meter.

As tested here, the 150 will suit 12- to 18-pound models with 6- to 7-foot spans (depending on speed and wing loading). The props recommended range from 15x8 through 16x10 and up to 20x6; this implies an rpm range of from 7,000 to 9,000 but, as the power graph shows, the 150 has strong potential well below 7,000rpm, and the lowest practical rpm level is around 5,500 (using a 20x10 Top Flite prop).

MECHANICAL DETAILS

A chunky, robust, structurally sound, one-piece crankcase follows the recently successful new Irvine 36 heli engine design, which was a significant departure from the long-standing Irvine 40-based crankcase. This new crankcase is shorter and more squat and has larger side transfer passages that will surely allow considerable future power increases, if needed.

The separate, pressed-in roller used as a crankpin and the separate propeller stud used in the original Irvine 40 design are no longer in evidence. Both had certain advantages, but they've been replaced by a more "normal" one-piece crankshaft of hardened steel.

The 0.072-inch-thick cast-iron cylinder liner is easy to push-fit into the case; it has several small Schnuerle ports: four exhaust, six transfer and two boost. This earlier style of cylinder multi-porting prevents the rotatable Dyke's piston ring from jumping out into any one port. The more difficult alternative is to pin the ring to prevent it from rotating. As we've seen, breathing restrictions have been built into the design, so smaller ports are acceptable.

The piston has been machined out of

PHOTOS BY MIKE BILLINTON

WEIGHTS AND DIMENSIONS

Capacity	1.5105ci (24.75 cc)
Bore	1.300 in. (33.03mm)
Stroke	1.138 in. (28.905mm)
Stroke/bore ratio	0.875:1
Timing periods	Exhaust—44°
	Transfer—113°
	Boost—102°
	Front induction
	Opens—47° ABDC
	Closes—46° ATDC
	Total period—179°
	Blowdown—15°
Combustion volume	2.45cc
Compression ratios	Geometric—11.1:1
	Effective—8.26:1
Exhaust-port height	0.32 in. (8.13mm)
Cylinder-head squish	0.033 in. (0.838mm)
Cylinder-head squish angle	0°
Squish-band width	0.233 in. (5.92mm)
Carburetor bore	0.364 in. (9.26mm)
Crankshaft diameter	0.787 in. (19.99mm)
Crankshaft bore	0.516 in. (13.11mm)
Crankpin diameter	0.3125 in. (7.95mm)
Crankshaft nose thread	0.370 in. x 24 TPI (3⁄8 UNF)
Wristpin diameter	0.2755 in. (7.0mm)
Connecting-rod centers	1.892 in. (48.0mm nominal)
Engine height	4.87 in. (123.7mm)
Width	2.83 in. (72mm)
Length	4.75 in. (120.7mm)
Width between bearers	2.01 in. (51.05mm)
Mounting-hole dimensions	2.36x1.18x0.162 in. (60x30x4.15mm)
Exhaust-manifold bolt spacing	1.75 in. (44.5mm)
Frontal area	10.56 sq. in. (13.9 sq. in. with muffler)
Weight	34.8 oz. (986g.)—bare
	40.0 oz. (1134g.)—with muffler
Crankshaft weight	6.70 oz. (189.9g.)
Piston weight	0.65 oz. (19g.)

PERFORMANCE

Maximum B.hp

2.46 @ 11,100rpm (open exhaust, 5% nitro)

2.09 @ 10,209rpm (Bisson muffler, 5% nitro)

Maximum torque

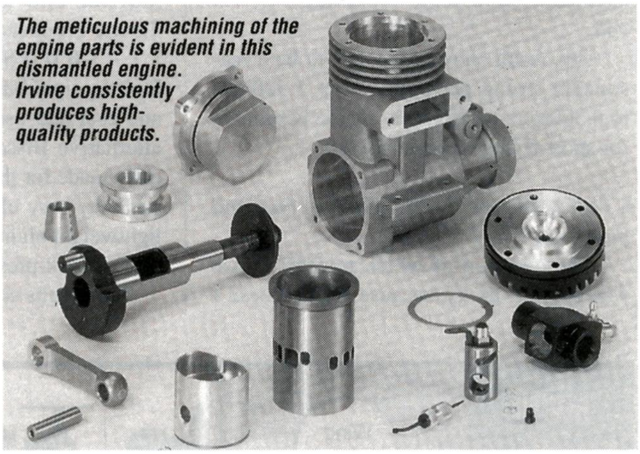
285 oz.-in. @ 6,700rpm (open exhaust, 5% nitro)

262 oz.-in.@ 5,500rpm (Bisson muffler, 5% nitro)

RPM ON STANDARD PROPS

	Open exhaust	**Bisson 13303 muffler**
22x10 Menz	–	4,395
24x8 Zinger	4,840	4,710
20x10 Menz	–	5,290
20x10 Top Flite	–	5,540
18x12 Menz	–	5,920
20x8 Top Flite	6,650	6,510
18x10 Bolly (3-blade)	6,720	6,550
18x7 Mastro	–	6,760
20x6 Zinger	–	7,120
16x12 APC	7,720	7,535
15x8 Graupner	9,560	9,280
PERFORMANCE EQUIVALENTS		
B.hp/ci	1.630	1.380
B.hp/cc	0.099	0.084
B.hp/lb.	1.130	0.836
B.hp/kilo	2.490	1.840
Oz.-in./ci	188.680	173.400
Oz.-in./cc	11.520	10.580
Oz.-in./lb.	131.000	104.800
Newton meter/cc	0.082	0.076
B.hp/sq. in. (frontal area)	0.233	0.150

Manufacturer/distributor: Irvine Engines, Unit 2, Brunswick Ind. Park, Brunswick Way, New Southgate, London, N11 1JL, U.K. **USA distributor:** Altech Marketing, P.O. Box 391, Edison, NJ 08818-0391; (908) 248-8738.



The meticulous machining of the engine parts is evident in this dismantled engine. Irvine consistently produces high-quality products.

solid, "medium-expansion" aluminum alloy fitted at a generous clearance of 0.008 inch in the cylinder liner. In keeping with the lowish rpm sought, cylinder timings are conservative—as is the crankshaft induction timing and the carburetor bore of only 9.26mm (3⁄8 inch).

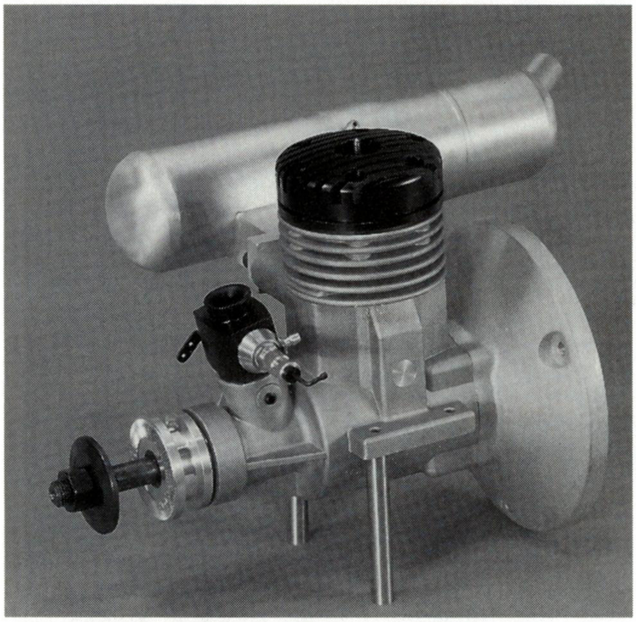
Irvine's use of the "L" cross-section Dyke's ring at the top of the piston crown has started a controversy here about the purpose and merits of this style of piston ring. One opinion holds that the "L" design assists and enhances the compression forces that push the ring sideways to maximize its seal against the cylinder wall (and initial ring tension can be less, so there's less friction). The other side says that the initial decision to fit a piston ring at the piston top (to achieve more precise exhaust timing) naturally leads to the "L" cross-section, and that the compression forces will get behind *any* piston ring, no matter what its cross-section, to force the ring outward. Meantime....

Throughout the 3,700rpm to just short of 11,000rpm operating band, the engine ran smoothly, uneventfully and vibration-free.

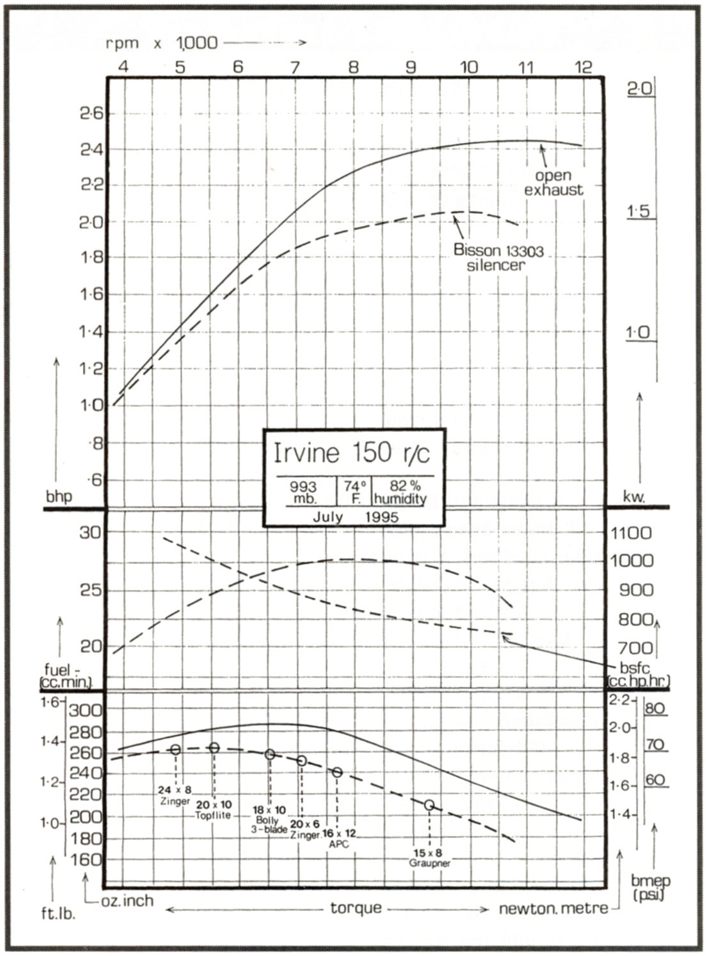
The black-finished, one-piece machined cylinder head has a 0.033-inch squish-band clearance and an effective compression ratio of 8.26:1, i.e., after the exhaust port has closed with the piston on its upward travel.

PERFORMANCE

A medium-expansion alloy piston running in a ferrous liner implies lots of temperature-related expansion differentials, so this engine benefits more from a careful running-in than most engines. In practice, the Irvine 150's good internal finishes helped to shorten this period; short, full-load runs with a variety of propeller sizes were



The Irvine 150 with a Bisson 13303 muffler on a radial mount. With a 20x6 Zinger propeller, this combination turned 7,030rpm and produced 98dB (measured from 9 feet away).



possible after 30 minutes of running-in.

• **Test 1. Open exhaust.** *Fuel: 5 percent nitro, 20 percent castor oil, 75 percent methanol. Glow plug: Moki idle bar, 1.5 volt.*

This result showed the 150 to be a reasonably strong performer from 5,500rpm to 8,500rpm; clearly, this engine is suitable for sport-flying ¼-scale aircraft.

• **Test 2. Bisson* 13303 muffler.** *Fuel and plug as in Test 1.*

The question of which muffler to use was slightly tricky because Irvine doesn't produce one. They did make available an O.S. BGX 35 muffler and a Tatone Products JT-3000S Snuffler unit, but on the grounds of weight and cost and use in the USA, I chose the alternative Bisson 13303 muffler specifically made for this engine. Relatively inexpensive, very effective and well-made of lightweight aluminum, Bisson mufflers are typical back-pressure devices.

Test results confirmed the superior, low-ish rpm operation that had been predicted by the propeller rpm checks in open exhaust and muffler modes. Because of the generally restrictive nature of the 150's portings, exceptionally good fuel consumption was recorded.

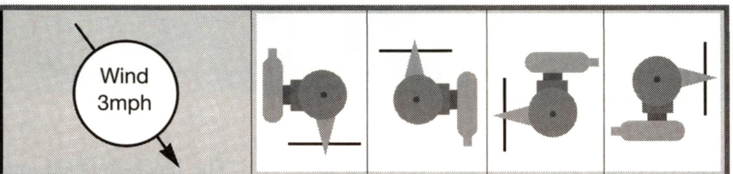
Throughout the 3,700rpm to just short of 11,000rpm operating band, the engine ran smoothly, uneventfully and vibration-free.

• **Idling.** Using the 20x6 Zinger and the test fuel, a muffler pressure to fuel tank rpm down to 1,430 was obtained. Carburetor settings to achieve both this and the full-throttle rpm of 7,120 were: main needle—2.5 turns open; secondary needle—4 turns open. These settings gave good crisp response from the Irvine Jetstream rotary-barrel carburetor.

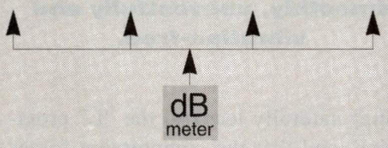
Finally, the design and construction of "large" model engines is a comparatively new venture for Irvine, whose long reputation was founded on engines of between .20 and .61ci. This new 150 shows all the signs of becoming an equally well-accepted unit. At the end of the tests, the engine was in very good condition; Irvine has got it right.

**Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

IRVINE 150 dB LEVELS



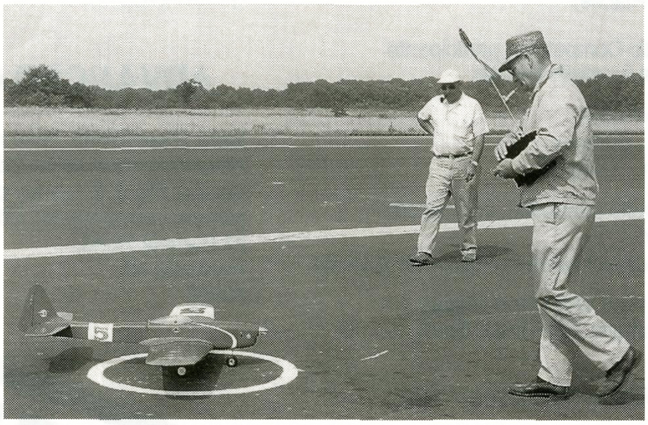
9 feet. AMA/S=USA	Bisson 13303 muffler 20x6 Zinger 7,030rpm	98	94	92	96
7 meters BMFA/UK	As above	88	81	83	87



Engine: Irvine 150 Sport R/C with Bisson 13303 muffler
Fuel: 5% nitro
Temperature: 89° F
Humidity: 56%
Pressure: 996 millibars
Meter: Radio Shack type 33-2050 using GA601 calibrator set to NPL standard
Height: meter and engine set 1 meter above concrete surface
Location: outdoors, next to farmland

HAL deBOLT

A PROTOTYPE PATTERN SHIP



Caller Harvey Thomasian approves as deBolt "spots" the Interceptor Mk V at a New England Championship.

THE INTERCEPTOR pointed the way to modern pattern aircraft. It hardly seems possible that it's now more than 32 years old! We should appreciate the era in which it originated; 1963 was the time of the Taurus, the Perigee, the Kwik Fli and many others that were a step above the first attempts to solve the mysteries of pattern.

In those days, much of a competitor's time was spent ensuring that the finicky radios and engines would operate as expected. Add the chore of building the model (pattern rules required that the pilot build his entry), and you'll see the advantage of using a simple design. With the advent of propo, systems gained some simplicity; similarly, engines were also improved. It seemed that there might be time to devote to improving the model design.

As early as 1961, I had dreams of improving my model designs, but I felt that several items were needed to make a complete package. Ideas, however, were germinating—among them, the need for a retractable landing gear, and obtaining that would take some time.

The concept of "retract gear" required that every unit be identical so that interchanging them would not be a problem. Additionally, they should be electric powered to eliminate the need for an additional power source. Gear legs should also be attached in such a way that adjustments could be made to their position and length. Jack Roth's company was given the task of producing the gears, which were made professionally. (The trials and tribulations of the effort would make another story!) The "Viscount" model was used to perfect and evaluate the gears for utility and longevity.

BUILDING THE ULTIMATE PATTERN SHIP

During the time it took to make the retract gears, Orbit introduced their improved version of the Space Control analog propo systems, and it was very reliable. Also, Merco offered new R/C engines that were greatly improved in both power and reliability.

The parts for an ultimate pattern design were at last available. It was time to put up or shut up! The objective was to go all out and use the most advanced aerodynamic principles with little consideration for complexity or building time. The structure should be robust but ultralight.

Interceptor Mk V scored within three points of perfection at a Philly Nats.

The biggest consideration should be streamlining, which obviously affected the structure. Before the design was finalized, much research was done, and many erasers were expended!

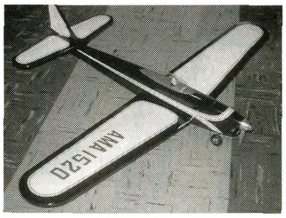
As it should be with any aircraft, the wing was the first consideration. Planform research indicated that a 2:1 equal taper with rounded tips came close to the efficiency of the ideal ellipse. Choice of airfoil was another major consideration; previous success with the NACA 65000 indicated that maximum lift with low drag plus stability would make the best airfoil. Airfoil data indicated maximum efficiency with 12 to 15 percent thickness.

In choosing the airfoil, two considerations were paramount: the wing should be deep enough in the center area to enclose the retract gears, and we needed tip stability. Though all 65000 foils were considered stable, data showed that the 65012 would "keep flying" several degrees past the stall angle. The choice became easy: use a 65018 at the root and progress to the 65012 at the tip; this would create an efficient average thickness of 15 percent. A very pretty, neat wing was conceived. The stable 65012 section was also chosen for the tail surfaces, even though the required structure would be complex.

The size of the fuselage was determined by how much room the equipment would require. A minimum was determined and, in the plans top view, a symmetrical airfoil shape was developed to enclose it. Equipment was bulky then, so the fuselage had to be larger than it would have to be today.

Aerodynamics tells us that drag is not good, so great effort was made to reduce it. This included completely cowling the engine; the simplicity of this, plus obtaining the desired thrust-

line location, dictated the use of an inverted engine. Anticipated starting problems were solved by adapting an engine-starting routine to prevent it.



Interceptor Mk I pointed the way to modern pattern .

Drag-reduction efforts included minimizing protuberances. The wing was attached with a camlock, so rubber bands weren't necessary. The elevator horn was within the fuselage. The only projections that were left were the needle valve and the rudder horn, both of which proved difficult to enclose. If you study the photos, you'll find other niceties that were included to produce a clean aircraft; no holds were barred!

As with the aerodynamics, considerable attention was given to the structure. The wing was basically $\frac{1}{16}$-inch-thick balsa sheet covered with silkspan. The fuselage was $\frac{3}{32}$-inch-thick sheet covered with the then-new $\frac{3}{4}$-ounce glass cloth and epoxy. The finish was the revolutionary (at the time) HobbyPoxy. The result was a robust plane at the desired weight. With its 68-inch span, the 6-pound Interceptor enjoyed a light (for then), 20-ounce-per-square-foot wing loading, so it ran well on the .49 engine used.

READY TO SOAR

The Blue Angels had just come onto the scene, and duplicating their aerobatics style seemed logical for pattern competition. Even the first Interceptor flights showed a most "groovy" flier with above-normal flight speed and rate of climb. Blue Angel-type performance was its cup of tea! Best of all, it was docile to fly and really looked good in the air.

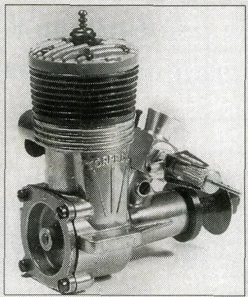
Naturally, a problem had to pop up. The Ceptor had a fishtailing tendency in wind gusts. Several aerodynamic "cures" were tried, such as more fin area, dorsal fins, etc., but to no avail.

A fellow modeler was in charge of a local wind tunnel. In desperation, we asked him to check the Interceptor. His diagnosis was that the wing-to-fuselage

EARLY R/C POWER

When R/C exploded onto the scene, CL was in its prime; naturally, engine manufacturers concentrated on this phase. Because the R/C trend was slow to start, for R/C power, you had to "make do" with whatever was available.

At first, all that was needed was enough power to fly the rudder-only craft, so no one was concerned with creating better power sources. It was better to concentrate on the mysterious control system and just fly until the fuel was exhausted!

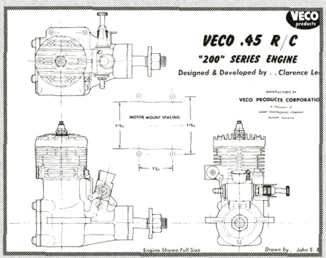


K&B's early R/C engine used a barrel-style venturi air valve plus an exhaust valve—very popular in its time.

When second-control capability was realized, however, thought turned to engine-speed control, and modelers came up with inventive ideas. We knew a rich engine ran more slowly than a lean one, so the first attempts at improvement were aimed at having both. In general, two methods evolved. One was a "butterfly valve" in the venturi to control air intake. The second was to have two needle valves; when the second valve operated, the engine ran richer. Because needle settings were very critical to reliability, both methods proved marginal at best.

Someone discovered that if you blocked off the exhaust, speed was reduced without any particular effect on the needle setting. So, even though speed changes were not great, the "exhaust valve" became popular.

Innovative modelers concocted all sorts of gadgets to accomplish these purposes. "How to's" were the order of the day!



The Lee-Veco .45—forerunner to today's R/C engines.

Before the manufacturers got to it, the breakthrough that led to the modern carburetors occurred. We developed a speed control out of a Mills Diesel rotary-valve fuel shut-off (free-flight use). Bramco marketed these first R/C carburetors.

Early on, K&B Mfg. was aware of R/C'er needs. They adapted the "barrel carb" and an exhaust valve to their .35 engine, which became *the* R/C engine. When more power was needed, they simply "bored out" the .35 to create a .45. Initially, it was a vibrating fool, so they added an "internal counterweight" (see photo). The K&B .45 soon became the most popular R/C engine to that date.

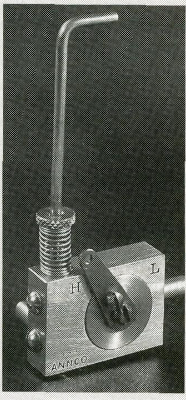
The granddaddy of today's R/C engines was probably Clarence Lee's .45—a jewel of an engine! Later, Veco put it into mass production. For the first time, with its ball bearings, there was a long-lasting, reliable engine. The Veco .45 still used an exhaust valve and barrel air control, because the modern carb had yet to come!

joint created a strong vortex that tended to blank out the vertical tail. The plane's reaction to this was enhanced when the tail needed to work the hardest. The problem was fixed by adding a large "fillet" to the wing-fuselage joint. Eureka!—no more fishtailing!

The Interceptor went through several variations with no changes to the basics. They all served me well and would serve you well, too.

Because this article was produced from memory, there is probably more that could be said. But I hope you can appreciate the effort this "first" required; we were forging new frontiers!

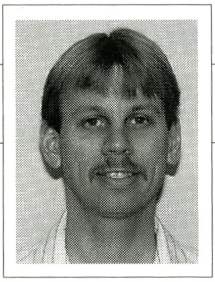
Have fun! ■



For low speed, this remote needle valve could be switched from lean to rich.

We found that having an auxiliary air intake to the carb barrel solved the engine's tendency to become too rich at low speed. Johnson was probably first on the market with the "Dyna-Mix" carb, which controlled both fuel and air simultaneously, just like many modern carburetors.

When we think of the great effort it took to develop our modern radios, we should remember that as much effort went into creating the engines. And innovative modelers showed the way!



MICHAEL LACHOWSKI

ONLINE INFO AND COMPUTER MIXING

THIS MONTH, I've gone technical with plenty of computer-related items. First, I'll talk about taking advantage of programmable mixers on your computer radio to provide more advanced mixing. Next, I want to point out some Internet resources that might be handy for those of you in the colder climates this time of year.

CALCULATING JR-388 MIXER SETTINGS

Simple mixer SP-E value: -20
Stick travel: +166 to -166
Intermediate point, SP-E value of -30 at +90 stick position.

Program information for additional mixer (SP-E mix)

Mix = [full_mix - intermediate_mix] * [(max_stick - min_stick) / (intermediate_stick - min_stick)]

Offset: 90
Mix: [-20 - -30] * [(166 - -166) / (90 - -166)] = +13

ELEVATOR COMPENSATION CURVES

Computer radios provide mixers to allow elevator-trim compensation for landing glide-path controls such as flaps or spoilers. The mixer adjusts the elevator to counteract the pitch changes when these control surfaces are deployed. These are linear mixes that adjust the elevator proportionally to the flap or spoiler setting. They only permit the mix to be optimized for one setting. Typically, the mixer setting provides proper elevator compensation for full flap or spoiler.

Most of the time, this simple linear mix is close enough at intermediate control points and requires only a minor elevator correction. But it would be better to have a mixer that has different mixing rates over segments of the flap travel. This capability is present in high-end radios like the Futaba 9ZAP and the JR PCM-10SX, but what can you do with a less expensive radio?

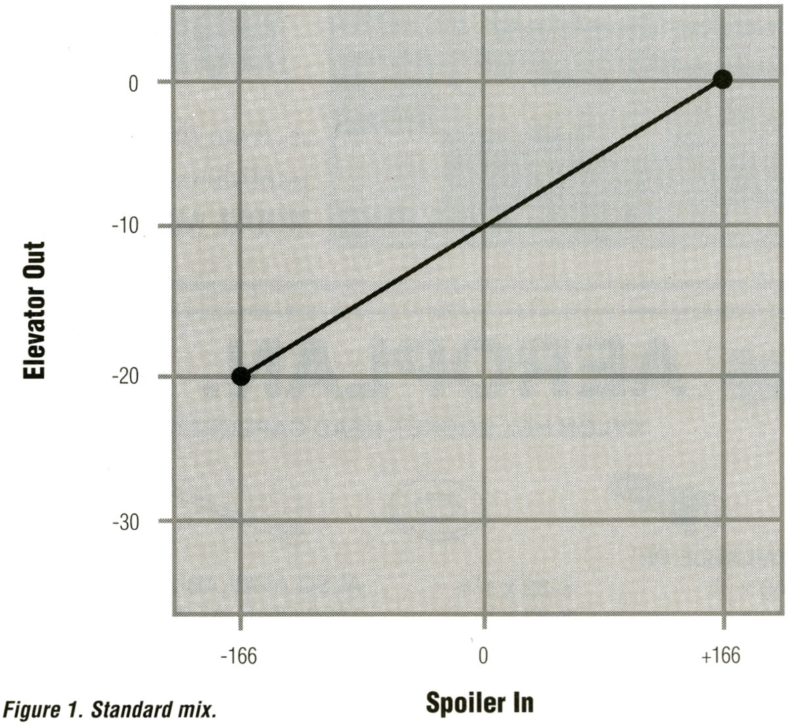


Figure 1. Standard mix.

With some experimentation, a second mixer can be combined with the first mixer. Setting the mixers can be confusing, but when properly executed, your reward is a model that has very little pitch-up or -down at any flap setting. Your flap stick now becomes a speed control that is very easy to use.

To show you how to do this, I'll take you through the case in which you need extra elevator compensation over the first half of the flap travel. Through flight testing, you'll need to determine the compensation for the full flap setting. You should already have this mixer travel. Unless you want to figure out the math, measure the elevator travel at full flap.

Now start to readjust this mixer to achieve the proper intermediate mixing value. Watch out near the full-flap deflection as you now have too much elevator compensation. Program up a free mixer to take input from the flap stick and output to the elevator. Set the zero point on this mix to your "intermediate" point, and put in a mixer value with the opposite sign of your normal elevator compensation on the one side of the mixer. Get out your ruler, and adjust this mixer until it

returns the elevator back up to the original single-mixer position.

Making further adjustments is a two-step process. You can make endpoint adjustments with the second mixer. Midpoint adjustments require changes to both mixers. Take your time, and record your settings.

INTERNET SOARING RESOURCES

Over the past nine months, I've been running an R/C soaring mailing list on the Internet. It's a great way to keep track of soaring events and meet pilots from around the world. If you're wondering how many are active, the list of addresses has grown to more than 600 during just six months, and it includes members from over 25 countries. A number of folks have also come and gone over that time.

If you were a subscriber, you would have read a number of reports on the status of the recent LSF/AMA Nationals and the F3B World Championships without having to wait months for the traditional magazines. Several members reported on some of the national and international soaring events in Europe.

Many of you are not contest-oriented, but you would have enjoyed a variety of thermalling discussions and some excellent building tips and personal experiences with the many kits in the soaring marketplace.

The mail traffic on the list can be overwhelming for some, so there are two ways to subscribe. Most of those who access mail through a dial-up model find the "digest" version of the list most manageable. Subscribers receive approximately one message a day that contains all the messages posted to the soaring mailing list.

Most of the list operations are automated by a computer at Air Age Publishing that runs software called "Majordomo." The list itself does not cost anything to use. Of course, you still have to pay for the mail message or connecting charges to your local service provider. If you're new to the Internet, you might want to read the mail for a while before posting messages of your own. Be sure you put some thought into your messages, because they'll be read by hundreds of people from around the world. Actually, it may be *thousands,* since some of more insightful "posts" get reprinted in club newsletters.

SOARING ON THE WEB

The popular media has taken to the Internet with frequent stories and plenty of hype. Several modelers and a few manufacturers now provide information on the World Wide Web. Sometimes, it's known as Netscape or Mosaic after the browsers or programs that let you access this information. These locations have addresses called URLs (see sidebar), and they tell the programs where to find the information on the Internet.

My favorite is the site run by Michael Selig at UIUC. It offers all the latest wind-tunnel-test results and status reports, and there's a very extensive list of airfoil coordinates that includes all the

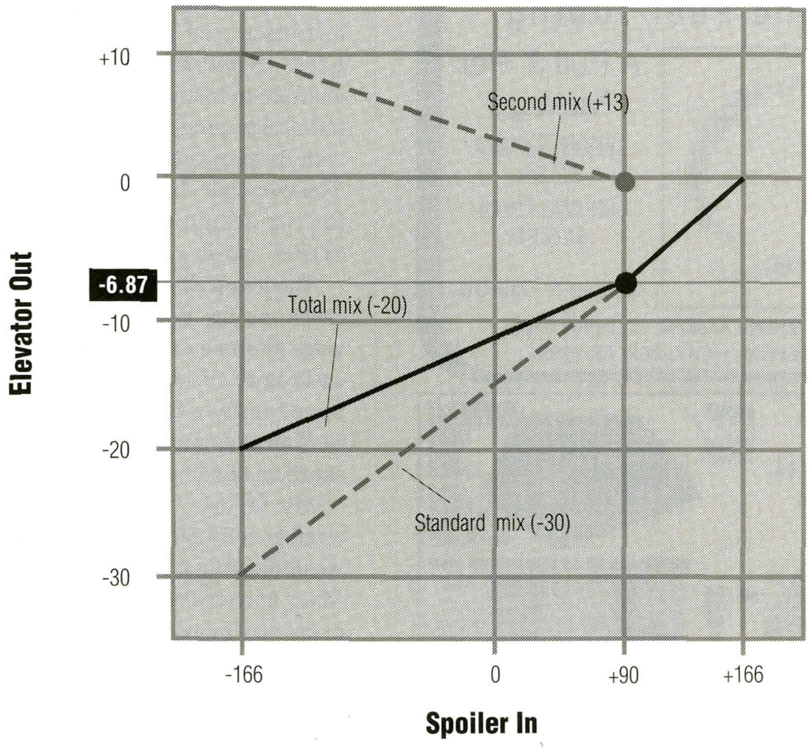


Figure 2. Two mixes combined (second mix starts at +90).

URL LIST

Here are a few interesting URLs to get you started. By following the links in some of these pages, you should find many other soaring-related sites.

Michael Selig and UIUC testing—
http://uxh.cso.uiuc.edu/~selig/
Michael Selig's Profoil airfoil design program—
http://opus.aae.uiuc.edu/~airfoils/
Waco Catalog online—
http://www2.ari.net/home/waco/
BARCS—
http://www.pncl.co.uk/~coppice/barcs.html
Michele's Hangar—http://ram-pages.onramp.net/~micheleb/hangar.html
Jim Markle—
http://www.kaiwan.com/~markle/number1.html
Lee Trujillo—
http://www.cudenver.edu/~trujill/RC/index.html
National Weather Service Forecasts—
gopher://wx.atmos.uiuc.edu/11/States/

HOW TO USE THE LIST

• *To subscribe to the digest version of the list, send e-mail to:* **soaring-digest-request@airage.com**
Put the word **subscribe** in the message and nothing else.

• To subscribe to the regular version of the list and get lots of messages, send e-mail to: **soaring-request@airage.com**
Put the word **subscribe** in the message and nothing else.

• *To post a message, send your e-mail to:* **soaring@airage.com**

• To "unsubscribe" from the list, send e-mail to: **soaring-digest-request@airage.com** or **soaring-request@airage.com** (depending on which list you want to unsubscribe from).
Put the word **unsubscribe** in the message and nothing else.

airfoils tested in Princeton and at UIUC. Even more interesting is the interface to Michael Selig's Profoil airfoil-design program. You can interact with the program directly on the Web. You even get the input specifications for the design of the ever-popular SD7037 airfoil as a starting point.

The less technically inclined should check out the Waco Web site. It provides information from the latest Waco catalogue. Frank Weston has also placed many articles from past Waco Technical Journals online—plenty of excellent building and flying tips.

My favorite Internet resource is weather information. All the national weather-service forecasts are online. Many universities provide high-quality maps and images using satellite and radar information that equal or exceed anything that's available elsewhere.

If you Net-surf for fun, there are plenty of other aviation-related sites out there. See you online! ■

NAME THAT PLANE

CAN YOU IDENTIFY THIS AIRCRAFT?

If so, send your answer to *Model Airplane News*, **Name That Plane Contest** (state issue in which plane appeared), 251 Danbury Rd., Wilton, CT 06897.

CONGRATULATIONS *to* Lee J. Barmakian of Worcester, MA, for correctly identifying the October '95 mystery plane. The Sopwith "$1\frac{1}{2}$ Strutter" got its unofficial name because it had only one pair of main wing struts per side and a short pair of struts (the $\frac{1}{2}$) that ran from the fuselage to the bottom of the top wing. The French were responsible for most of the 5,700 that were built. The two-seater first entered service in the spring of 1916 and was powered by either a LeRhone engine or a 110 or 130hp Clerget rotary engine. In 1915, a Strutter was flown to 18,393 feet to break the British altitude record. With a 33-foot, 6-inch main wingspan, the 25-foot, 3-inch-long Strutter had a maximum takeoff weight of 2,250 pounds. With a flight-endurance time of $3\frac{3}{4}$ to $4\frac{1}{2}$ hours, its maximum level flight speed was between 98.5 and 106mph, and it carried the first synchronized Vickers machine gun and the first rear-mounted Lewis machine gun attached to a Scarff ring for the observer. Thanks to Charles Friend of Mansfield, OH, for sending in the photo of the Strutter. ■

The winner will be drawn four weeks following publication from correct answers received (on a postcard delivered by U.S. Mail), and will receive a free one-year subscription to *Model Airplane News*. If already a subscriber, the winner will receive a free one-year extension of his subscription.

CLUB OF THE MONTH

THYTUR

P.O. Box 5219, 125 Reykjaik, Iceland;
Internet: agbjarn@ismennt.is

The information about this month's club didn't come to us through the mail; it came over the Internet. Members of the Thytur (pronounced "fi-tur") model flying club share their modeling experiences with the world through their World Wide Web homepage titled, "Model flying in Iceland and how to build an airfield." On it, Agust Bjarnason explains how the 150 club members worked together to buy and prepare their flying field (which has two 70x7-meter paved runways) and clubhouse. Most of the work was done by volunteers. Agust says, "In such a large club, you have a specialist in almost every field: plumber, electrician, carpenter, economist, printer, engineer, mechanic, truck driver, etc., so you can do most of the work yourself if you don't mind sweating a bit. It is also relatively easy to get equipment and materials free if you talk to the right person, and someone in the club usually does!" To raise money for the field and the clubhouse, the Thytur members held several air shows with models and full-size planes, and nearly 50 club members have paid their dues for the next 10 years. Agust writes, "We take pride in keeping the site clean and attractive and have planted about 2,000 trees in the lava field near the clubhouse."

For their extraordinary effort and achievement in building and maintaining their flying field, we award the Thytur club members two complimentary subscriptions to *Model Airplane News*.

Congratulations! ■

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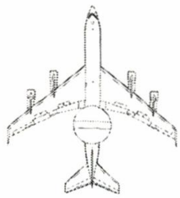


PRODUCT REVIEW

ASTRO FLIGHT

110D DC/DC Digital Peak Charger

by TOM ATWOOD

As THOSE OF us in the hobby who have a fondness for simplicity know, electrics are relatively easy to operate: turn on the radio and receiver, flip the power-system arming switch, add some throttle and fly. Besides piloting and enjoying the company of your buddies, one of the other things you need to focus on at the flying field is charging the batteries—a task that's simplified by using the right charger.

The Astro 110D trickle-charging a 10-cell 14mAh Sanyo pack.

Simple and efficient

What is the least you want a power-system battery charger to do? It should:

• reliably peak-charge the cells in your battery pack, whether in fast-charge or trickle-charge mode (trickle-charging is the best way to fully charge a new pack or balance the cells in a pack that has been on the shelf for a few months);

• handle more than seven cells, so that you can fly something with a little more spunk than your first electric trainer, if you so choose;

• have an adjustable-current dial so that you can fast-charge any battery pack you are likely to use, whatever its capacity;

• provide current at a constant charge rate, so that as the voltage of the battery being charged rises, the charge current does not slowly decrease (which would increase the charge time);

• be reliable and sturdy (resistant to "hangar rash");

• not cost an arm and a leg.

SPECIFICATIONS

- DC/DC digital peak charger.
- Trickle-charges one to 18 cells at 500mAh.
- Fast-charges one to 18 cells at 1 to 5 amps.
- Input power: 12V DC at 12 amps max.
- Short-circuit-protected at input and output.
- Retail price: $179.95.

110D CHARGER FEATURES

To see how the Astro Flight* 110D measures up to these requirements, let's take a look at its features.

Attached to the charger there are two cords—an output cord fitted with the Astro Zero Loss Racing Connector and a 12V DC input cord (with alligator clips). The 110D can be run off a 12V battery, or a 12 or 15V power supply. The charger's faceplate contains a start switch, a "re-settable" circuit breaker (no need to have extra fuses on hand) and a current-adjustment control.

To start the charger in trickle mode, you power up the system, connect the battery and hit the start switch. To fast-charge, you hit the start switch a second time. Adjust the charge current and you've finished; the charger does the rest. If you want to stop mid-charge, hit the start switch a third time—simple enough.

The charger trickle- and fast-charges battery packs containing from one to 18 Ni-Cd cells that have a capacity of 100 to 4000mAh. It uses a proprietary, 8-bit microprocessor that ensures proper peak-charging. How well? We spoke to renowned scale electric modeler and exhibition flier Keith Shaw. As we go to print, he hasn't recorded any false peaks in more than 150 documented charges; nor have we in our own testing. Its ability to maintain a constant charge rate has impressed us, Keith and others. Like other rugged, reliable Astro Flight products, the charger does what it's supposed to do—well.

Astro's microprocessor drives a two-line, 16-character digital display that, among other things, verifies that a full charge has been achieved. It displays:

• charge rate in amps;

• charge mode (trickle or fast);

• Ni-Cd voltage during the charge (at the end of the charge, it displays the actual peak voltage);

• total mAh of charge placed into the battery;

• total charge time in hours, minutes and seconds.

USING THE 110D

John Rist, who reviews speed controls and chargers for another Air Age publication, *R/C Car Action*, recently summed up using the system as well as anyone could.

"When you first plug the 110D into a 12V source, it flashes the Astro logo and then displays the message 'No Battery.' The unit that Astro sent me also flashes the words 'Property of John Rist'—a result of the personalized message feature. I talked to the owner of Astro Flight—Bob Boucher—and learned that this is a $20 option available from the factory (three- to four-week delivery). When you connect a Ni-Cd battery pack, the display flashes one of two messages: 'Overvolts Error' if the battery-pack voltage is above the 29.5V maximum; 'Ready to Charge' if the Ni-Cd pack's voltage is between 0.5 and 29.5.

"A press of the start button kicks the 110D into the trickle mode. The display now shows charge current, 'slow' (meaning slow-charge mode), elapsed charging time, and the charge placed back into the battery expressed in amp hours (Ah). The 110D trickle-charge mode is a true peak-charge mode. This makes it very useful for charging receiver packs and for placing the first charge on a brand-new racing pack. If, for some reason, the charger does not detect a peak, it will terminate the slow charge at the end of five hours.

"Press the start button again and, if in the trickle mode, the 110D will jump into the fast-charge mode. In the fast-charge mode, the current can be adjusted to between 1 and 5 amps. The charger will then turn off if it detects a peak but, if it doesn't, it will cut off after 45 minutes.

"At the end of a slow or fast charge, the display gives you the peak voltage of the Ni-Cd pack, the total charge time and the total charge in amp hours placed in the battery. With these three pieces of info, it is a snap to determine which of your packs is in peak condition and which is ready to be recycled. Buy the version with the custom logo, and you'll have a first-class charger that is 'theft-proof.' "

CONCLUSION

I have used the charger a few dozen times on a variety of battery packs and it has always done the job as advertised. At $179.95 retail, the charger is reasonably priced (chargers with extra "bells and whistles" cost considerably more). The Astro 110D DC/DC Digital Peak Charger does the important things you want a peak charger to do very well, and this enables you to focus better on the main thing—flying fun.

** Addresses are listed alphabetically in the Index of Manufacturers on page 170.* ■

CLASSIFIEDS

RATES: non-commercial—25 cents per word (no commercial ads of any kind accepted at this rate); commercial— 50 cents per word (applies *to retailers, manufacturers, etc.); count all initials, numbers,* name and address, city, state, zip code and phone number. **All ads must be paid for in advance.** To run your ad for more than one month, multiply your payment by the number of months you want it to run. Deadline: the 10th day of the month, 3 months in advance, e.g., *January 10 for the April issue.* We don't furnish box numbers, and it isn't our policy to send tear sheets. Please make all checks payable to: **AIR AGE, INC. SEND AD AND PAYMENT TO: Elise Silkowski, CLASSIFIED ADS, Model Airplane News, 251 Danbury Rd., Wilton, CT 06897-3035, or call (203) 834-2339.**

BUSINESS

R/C WORLD ORLANDO, FL, CONDO RENTAL: 2 bedroom, furnished. Available weekly or monthly. Low rates. 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For information, please call or write to R/C World, 1302 Stearman Ct., Orlando, FL 32825; (407) 380-6359.

FLY DAVE BROWN SIMULATOR. Use your transmitter. Works with Futaba, JR, Airtronics, Hitec. Uses Standard joystick connection. For more info, contact Computer Designs, 8530 N. Montana Ave., Helena, MT 59601; (406) 458-9416. [1/96]

SODA-CAN AIRPLANES—*replica biplane detail plans with* photos $7.50 PPD, Early's Craft, 15069 Valley Blvd. SP 26, Fontana, CA 92335. [8/96]

REPLICA SWISS WATCHES—18KT goldplated! Lowest prices! Two-year warranty! Waterproof! Divers, Chronographs, others! Phone (770) 682-0609; Fax (770) 682-1710.

NEW ZEALAND AERO PRODUCTS—Scale plans: Pawnee Brave, Pawnee, Airtruk/Skyfarmer, Agwagon, Fletcher FU-24, Cessna Aerobat, DC-3/C-47, Typhoon, Hall's Springfield Bulldog, Fairchild PT-19/Fleet PT-26, Rearwin Sportster and more. Fiberglass parts, hardware paks, color photo paks available. Free documentation with plans. Catalogue/price list: $5 (U.S.); Visa/MC. 34 Ward Parade, Stirling Point, Bluff, New Zealand. Phone/24 hr. fax—0064-03-212-8192. [2/96]

GIANT-SCALE PLANS by Hostetler. Send SASE to Wendell Hostetler's Plans, 1041 B Heatherwood, Orrville, OH 44667. [1/96]

SCALE AIRCRAFT DOCUMENTATION and Resource Guide. Larger, updated 1995 edition. World's largest commercial collection. Over 5,500 different color FOTO-PAAKS and 30,000 three-view line drawings. 168-page resource guide/catalogue $8.00; Canada—$9.00; foreign—$14.00. Bob Banka's Scale Model Research, 3114 Yukon Ave., Costa Mesa, CA 92626; (714) 979-8058. [2/96]

AERO FX BY JO DESIGNS—exact-scale, computer-cut, high-performance vinyl graphics and paint masks. Lettering; nose art; insignia for scale; pattern, pylon and sport fliers; complete graphic sets available. Call or write for free sample and catalogue. JO Designs, Rt. 1, Box 225 AA, Stratford, OK 74872; (405) 759-3333; fax (405) 759-3340. [5/96]

BOB FIORENZE BUILDING SERVICE. Jets, warbirds and helicopters. Contact Bob at (407) 330-1448. Our experience is your best assurance. [3/96]

ANTIQUE IGNITION engine parts: excellent reproductions, fuel tanks, points, timers, coils, needle valves, gaskets, etc. Champion spark plugs. Catalogue—$6 (intl. airmail—$8). Aero-Electric, 3706 North 33rd, Galesburg, MI 49053. [4/96]

PLANS ACCURATELY ENLARGED or copied. Any scale, any size. Money-back guarantee. Send $2 for info and a customized poster for your shop. Roland Friestad, 2211M 155th St., Cameron, IL 61423. [6/96]

PLANS ENLARGING. *Old model magazines, scanning, plotting,* model software. Free information. Concept, P.O. Box 669A, Poway, CA 92074-0669; (619) 486-2464. [2/96]

R/C WORLD ORLANDO—CONDO SALE - 2 bedroom, furnished on a 100-acre flying field with enclosed hangars. Close to Disney World and Epcot Center. For additional info, please call or write: R/C World, 1302 Stearman Ct., Orlando, FL 32825; (407) 380-6359.

VACUUM-FORMING—Your one-stop source for books, plastic sheets, components and ready-to-use machines in three sizes. New for '95, Hobby Vac System 2 machines. Free cata*logue—(800) 391-2974; Vacuum Form, 272B Morganhill Dr.,* Lake Orion, MI 48360. [1/96]

HELICOPTER SCHOOL. Five days of hands-on instructions with X-Cell helicopters and Futaba and JR computer radios. *Small classes, tailored to your individual needs, beginners to* expert. Includes all meals and lodging. Over 420 students from 23 countries and 44 states, logging 14,500 flights in the last five years. Located on a 67-acre airport used exclusively for R/C training. Owned and operated by Ernie Huber, five-time National Helicopter Champion. Send for free information and class schedule now! P.O. Box 727, Crescent City, FL 32112; phone (800) 452-1677; fax (904) 698-4724. Outside U.S., phone (904) 698-4275. [6/96]

GEE BEE plans (Benjamin used). Twelve airplanes, ⅓, smaller. Shirts! Catalog/News $4. Vern, 308 Palo Alto, Caldwell, ID 83605; (208) 459-7608. [1/96]

MAKE REAL DECALS with your computer and printer. Send $10 for introductory kit to: LABCO, Dept. MAN 27563 Dover, Warren, MI 48093. [2/96]

SOUTHWEST MODEL BUILDER. Full-line builder will build your aircraft from trainer to ducted fan, completely finished or ready to cover. Reasonable rates, satisfaction guaranteed. Call after 9 a.m.; (505) 891-4241. [1/96]

MODELMAKERS, COLLECTORS: *Aviation packets for sale.* Plans, 3-views, cutaways, drawings, engines, racing A/C, etc. $5 to $16. Send $1 and SASE for info. Doug Worthy, 1149 Pine, Manhattan Beach, CA 90266. [1/96]

PLANS - R/C sailplanes, scale, sport and electric. Old timer, nostalgia and FF scale and sport-powered, rubber and towline. All models illustrated. Catalogue $2. Cirrus Aviation, P.O. Box 7093, Depot 4, Victoria, BC V9B 4Z2 Canada. [2/96]

ANTIQUE IGNITION-GLOW PARTS CATALOGUE, ½ inch thick, timers, needle valves, cylinder heads, pistons, points, tanks, spark plugs, racecar parts, engines ½As, Baby Cyclones, McCoys, Phantoms, etc., $10 postpaid. (U.S.), $20 foreign. *Chris Rossbach, R.D. 1, Queensboro Manor, Box 390,* Gloversville, NY 12078. [2/96]

DETHERMALIZING CERTAINTY. For most free-flight models. Weighs .7 - 1.2 grams. large SASE to Wheels & Wings, P.O. Box 762, Lafayette, CA 94549-0762. [3/96]

LEATHER JACKETS: Made from high-quality Italian sheepskin leather, assembled in China. For catalogue, write to PMC *Enterprises, Dept. 1, Pier 19, The Embarcadero, San Francisco,* CA 94111. [1/96]

AVIATION HISTORY CATALOGUES: old, used, rare and out-of-print books on aviation, WW I, WW II, Korea, etc. To order catalogue, send $1 to: Q.M. Dabney & Co., Inc., Box 42026-AA, Washington, DC 20015. [2/96]

TV SHOW. The producers at Telstar Video Productions, Inc., *are proud to present the nation's only weekly half-hour TV show* dedicated to model aviation. "REMOTE CONTROL" television can be seen on Satellite Galaxy 4, channel 15 or on cable: The Outdoor Channel. Call (800) 972-4847, or fax (407) 220-4849 for affiliate list or more information. Note to manufacturers: 30- or 60-second commercial spots are available. Advertise your products on national TV to millions of potential customers! [3/96]

PLANS: Old-time and vintage plans including rare Australian and European models. Send U.S. $5 to Aircraft Artwork, P.O. Box 304, Kilmore 3764, Australia, or fax +61-57-821683 for comprehensive catalogue/plans list. Visa/Mastercard welcome. [1/96]

PLANS TO BUILD—more than 700 tools, machines and accessories for your shop. Catalogue—$1. Wood-Met, Dept. MAN, 3314 W. Shoff Cir., Peoria, IL 61604-5964. [9/96]

CHINO AIR SHOW VIDEO. The golden years of "Planes of Fame" air shows 1984 to the last show in 1989. Two-hour VHS from original tapes. Check or M/O for $19.95 to: Howard Wilson, Box 4409, Oceanside, CA 92052. [3/96]

ELECTRIC FLYERS—Specialty T-shirts show the world how you feel about electric flight and more! Club discounts. SASE for details. T. McDonough, P.O. Box 11088, Springfield, IL 62791-1088 *(email: timmed@cencom.net)* [1/96]

ELECTRICS ARE NOW: Catalogue of discount prices, plus bonus electric-flight information packet. $7 USA; $8.50 Canada; $10 overseas; Visa and Mastercard. CS Flight Systems, 31 Perry St., Middleboro, MA 02346; phone (508) 947-2805. [1/96]

CUSTOM ELECTRONICS AND SCALE DRAWINGS; submini car, Elevon or Crow *airborn mixers; F/F electronic 5-function* timers; rare & unusual scale drawings; illustrated catalogue $2; Bill Young Designs; 4403 E. Rustic Knolls Ln.; Flagstaff, AZ 86004. [4/96]

BOEING *80A* SCALE PLANS: ⅟₁₃ scale, trimotor landing gear. Accessories. Call or write: Sam Moss Productions, 909 Colebrook Dr., Santa Maria, CA 93454; (805) 739-9130. [1/96]

WW I PLANS AND MORE. Send $4 to Clarke Smiley, 23 Riverbend, Newmarket, NH 03857. [4/96]

GET YOUR HEAD ON RIGHT—your glow plug too! Tork-It precision torque screwdriver. Free info/torque specifications; (770) 736-0916. [3/96]

MIXERS & RETRACT CONTROLLERS! MicroMixer for flaperons, elevons, V-tails, flying wings! MicroRetracts sequences 3 servos in slow motion from one channel! These are tiny ⅓-ounce airborne computer controllers for standard radios! Without connectors, $29 each plus $2.25 shipping, Quillen Engineering, 561 N. 750 W., Hobart, IN 46342 (219) 759-5298. [1/96]

MILITARY AIRCRAFT PHOTOS—20" x 28". Available framed or unframed. Makes great Christmas gift. Call, write for a catalogue sheet. The Chessler Company, 4211 Primrose Ave., Baltimore, MD 21215. (410) 358-5161; fax (410) 764-7451. [1/96]

LARGE-SCALE SAILPLANES AND TOWPLANES—new and used—call (212) 879-1634, Sailplanes Unlimited, 63 East 82nd St., New York, NY 10028. [5/96]

MINI TURBOFAN JET ENGINE—715-d for model airplanes. Replaces most ducted fan units. For catalogue, send $5: JMW, P.O. Box 2311, Dept. 2, Long Beach, CA 90801. [2/96]

FOR RELIABLE POWER system setups, send your O/S 91 engine, Dynamax fan and pipe. We will assemble, adjust and test fly. $60 labor. Bob Fiorenze (407) 330-1448. [1/96]

INSTRUCTIONAL VIDEO. For 50 years, I have been a mad keen aeromodeler and am proud that during this time I have been able to help hundreds of less experienced modelers with tips, techniques and advice. Last year, with the encouragement of the *Model Aeronautical Association of Australia, I produced* a 90-minute video entitled, "How to Build, Trim and Fly a Model Aircraft." The response here in Australia was so tremendous that I am pleased to now offer the video to my fellow modelers in the USA. Price is only $US 19.75 plus $5.25 to cover packing and airmail postage. Write to me, Paul Straney at P.O. Box 304, Kilmore, Victoria, Australia, or fax +61 57 821 683. Mastercard/Visa welcome. [2/96]

ULTRALIGHT AIRCRAFT—Hear our "Fast Action Classifieds." Call 1-800-411-0042. You can learn to fly the real thing. Buy, sell, trade, kit-built, fixed wings, powered parachutes, rotor, sailplanes, trikes, ballons and more. Stories galore! *Sample issue $3. Annual subscription $36.* Introductory offer of only $24. (813) 539-0814; Ultraflight Magazine, 12545 70th St., Largo, FL 34643-3025. [1/96]

DEBOLT PLANS: radio control; free flight; control line. Separate SASE for each list to: Fran Ptaszkiewicz, 23 Marlee Dr., Tonawanda, NY 14150-4321. [3/96]

GERMAN AIRCRAFT WW II—handbooks, service-parts lists, instruction manuals. List for $2. Udo E. Hafner, Konigsallee 69, D-71638 Ludwigsburg, Germany. [2/96]

HISTORIC REPLICAS: DISCOUNTS! Luftwaffe bullion unit emblems, Flying Tigers, 94th Aero, Lafayette Escadrille accessories, Air Force bullion patches, shirts, wings, medals, beer steins, scarves, WW I squadron pins from $4.95. Free gift with order. Catalogue $1, refundable. Company of Eagles, 875A Island Dr., Ste. 322N Alameda, CA 94502. [3/96]

CLASSIC AIRCRAFT COLLECTION, LTD. presents post war and WW II I.D. Recognition Models. Quality replicas, *black and gray plastic originals are displayed in aviation museums worldwide.* 1/72 scale, 170 different models. **The Racer Series of the Golden '30s** museum-quality models 1/48 scale in magnificent color and detail, 12 different models. **The Seaplane and Flying Boat Series** of 40 years of aviation history. Museum-quality models in authentic color and detail, 1/72 scale, 14 different models. Free brochures, Classic Aircraft Collections, Ltd., 3321 Suffolk Ct. W. #105, Fort Worth, TX 76133; (800) 289-3167. [1/96]

R/C SKYDIVING: New Ram-air parachute now available. Illustrated catalog $1. R/C SKYDIVERS, Box 662L, St. Croix Falls, WI 54024. [6/96]

TALES OF AN ANCIENT MODELER: Funny, nostalgic stories of how modeling used to be. With 100 photos spanning 60 years. $15 pp. USA. Norm Rosenstock, 124 Granada St. RPB, FL 33411. [3/96]

PLANS—Flying Flea (full size) plans: HM14 $45, HM16 $125. Archive, Box 892, Wooster, OH 44691. [6/96]

"SPEED KING" BOOK. Air racer Rudy Kling and his giant-killing 1937 Folkerts in aviation's "golden age." $20 postpaid. LRA, RD5, Box 41, Dunderberg Rd., Monroe, NY 10950.[1/96]

PLANS: Planes of the Golden Age of Aviation. 1/4 & 1/5 scale plans, etc. Catalog $1. Norm Rosenstock 124 Granada St., RPB, FL 33411 [3/96]

V/STOL DESIGN CONCEPTS. Illustrated book on full-scale vertical takeoff and landing aircraft, applicable to R/C models. $10 postpaid ($15 outside USA). Spirit Publications, Box 645, Pahoa, HI 96778. [1/96]

FREE XQ-500 FUEL LUBRICANT SAMPLE! Improves performance, faster starts, cooler operating temperature, longer running time between fill-ups. Amazing results! Rush 2 stamps. PMP, 84 Park St., Kalispell, MT 59901. [4/96]

BUILD BETTER, FASTER MODELS. Britain's finest R/C magazines will show you how! Whether you are a modeler or a flier, we have just the right magazine for you. To find out more about the magazines we handle, send a large SASE to Wise Owl Publications, 4314 W. 238th St., Dept. MA, Torrance, CA 90505. [2/96]

WE NOW OFFER MORE CASH, new engines, new kits and new radios for your old engines, ignition engines, twins, parts, old gold and silver coins. Now available - Ultra Precision Scale Plans *that qualify for IMAA meets—81-inch wingspan. Send $2 & SSAE* for giant catalog of recent arrivals to: Carl V. Miller, 1773 Blueberry Dr. N.E., Rio Rancho, NM 87124; (505) 891-1298. [1/96]

HOBBYIST

WANTED: Model engines and racecars before 1950. Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [10/96]

ENGINES: IGNITION, GLOW, DIESEL—new, used, collectors, runners. Sell, trade, buy. Send $3 for huge list to Rob Eierman, 504 Las Posas, Ridgecrest, CA 93555; (619) 375-5537. [5/96]

MAGAZINE BACK ISSUES—*American Modeler, American Aircraft Modeler, Aeromodeller, Model Airplane News, Model Aircraft, RCM* and more; 1930s–1990s. For list, send SASE to Carolyn Gierke, 1276 Ransom Rd., Lancaster, NY 14086. [3/96]

WANTED: ignition model engines 1930s to 1950s, especially Elf, Baby Cyclone, Brown Jr., Ohlsson Custom and Gold Seal. Also model racecars, any parts, spark plugs, etc; Woody Bartelt, 3706 North 33rd, Galesburg, MI 49053; (616) 665-9693, or (800) 982-5464. [4/96]

CASH FOR ENGINES: ignition, glow, diesel–all types; any condition; sale list, too! Estates my specialty! Send SASE for list. Bob Boumstein, 10970 Marcy Plaza, Omaha, NE 68154; (402) 334-0122. [5/96]

WANTED: Old, unbuilt, plastic model kits from '50s and '60s. Send list, price to Models, Box 863, Wyandette, MI 48192. [2/97]

ENGINES, KITS & ACCESSORIES: 35-year collection for sale. For listing send #10 SSAE to: Ed Hagerlin, Box 1980, Overton, NV 89040. [2/96]

MODEL AIRPLANE NEWS, 1930-1980; "Air Trails," 1935-1952; "Young Men," 1952-1956; "American Modeler," 1957-1967; "American Aircraft Modeler," 1968-1975. $1 for list. George Reith, 3597 Arbutus Dr. N., Cobble Hill, B.C. Canada V0R 1L1. [2/96]

COLLECTION FOR SALE: *Over 350 kits from 40's, 50's, 60's*, F/F, R/C, U/C, Rubber, Solids, Jetex. Send SASE ($.55) *to Dr.* Frank Iacobellis, 62 Palisade Rd., Rye, NY 10580, or call (914) 967-5550. [1/96]

MODEL MOTORS WANTED: most types, 1970 and earlier. Cash or trade. T. Crouss, 100 Smyrna, West Springfield, MA 01089. [6/96]

WANTED: Cox, Wen-Mac, Testors, etc. Gas-powered plastic cars, planes, boats. Please call or write. Dean Barham, 4032 Iowa St., San Diego, CA 92104; (619) 528-1680. [4/96]

SLOT CARS WANTED: Cox, Aurora, Tyco, etc. 1960's, 1970's vintage; any scale. Please call or write. Dean Barham, 4032 Iowa St., San Diego, CA 92104; (619) 528-1680. [4/96]

WANTED: 12-inch G.I. Joe and Captain Action. Jeff Gilbert, 423 S. Randolph St., Princeton, IL 61356-1960. [3/96]

P-38 LIGHTNING—LOVE IT? Join a group of P-38 modeling and full-size enthusiasts. Share modeling, flying, historic facts *and articles about the P-38. Entering fee of $15 covers newslet*ters and club patch. For more information, write: P-38 M.O.I. Ron Parker, 3003 Windchase, #1003, Houston, TX 77082-3444. [4/96]

ANTIQUE MAGAZINES: Complete private collection. Bill Barnes Pulps, Air Trails, Flying Aces, others, $1 for list. Bruce Thompson, 328 St. Germain Ave., Toronto, Ontario, Canada M5M 1W3. [3/96]

WANT TO BUY: Cox .35 and .40 engines. Thanks. Please *write Dean Barham, 4032 Iowa St., San Diego, CA 92104;* (619) 528-1680. [3/96]

WANTED: Futaba single-stick helicopter radio, whole system or transmitter only. Robert (814) 825-8404. [2/96]

INTERESTED IN OLDER SCALE airplane balsa kits, Cleveland plans, and wood kits of race cars. Good used engines, building supplies/material, radio control accessories, etc., are also of interest. Please list condition and best price. I will buy one piece or entire collection. Randy Christensen, 1113 Balboa, Denison, TX 75020. [2/96]

HUGE TOWPLANE—will tow the largest sailplanes. 1/3 L5 with Saks 8.4 twin and Futaba servos. Mint condition. $2,500.00; 1/3 Christen Eagle, NIB—$350. Contact Robin Lehman (212) 744-0405. [1/96]

SALE—Getting out of the hobby. All finished airplanes, support equipment, miscellaneous tools and parts. For listing, send #10 SASE to G. Hunicke, 18 Media Dr., St. Louis, MO 63146. [1/96]

FOR SALE: K&B .61 R/C engine with carb and muffler and bolts. New motor, *never been run. Still in original box.* Paid $150; sell for $80. Please call or write (817) 699-1274. Ronald Kilgore, 1103 Park Hill Dr., Killeen, TX 76543. [1/96]

WANTED: *Model engines and racecars before 1956.* Don Blackburn, P.O. Box 15143, Amarillo, TX 79105; (806) 622-1657. [12/95]

WANTED: Built or partially built scale Cessna 150, 152, or 172. Glen Mills, P.O. Box 3393, Mission Viejo, CA 92690; phone (714) 768-0585; fax (714) 458-6455. [12/96]

CARS. Selling model collection, 1973 issues up, 1/24-1/25, individual prices, about 800. Ralph, Box 2423-P, Yakima, WA (509) 965-0670. [6/96]

FOR SALE: Fox Buzzard 12-foot glider kit $175 ppd. R. Elledge, 3561 S. Biscayne, Northport, FL 34287; (941) 426-4771. [1/96]

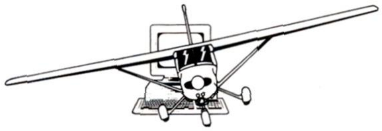
SLOT CARS AND SLOT-CAR-RELATED ITEMS wanted from the 1960s. Will pay finders fee. Emmett Hunt, 39651 Michigan Ave., Canton, MI 48188. (313) 729-7568 (SLOT), fax (313) 729-8780. [4/96]

Paying $60 to $125 *for toy metal outboard boat motors:* Gale, Seafury Twin, Oliver, Johnson, Mercury, Scott, Evinrude. Gronowski, 140 N. Garfield Ave., Traverse City, MI 49686. (616) 941-2111. [5/96]

EVENTS

LARGEST SWAPMEET AND AUCTION IN ILLINOIS! 140 tables. Hosted by the Tri-Village RCer's on Saturday, February 3rd, 1996, at the DuPage County Fairgrounds, Wheaton, Illinois. Vendor set-up at 8:30 a.m. General admission at 10:00 a.m. Dedicated selling hours: 10 a.m. - 3:30 p.m. FREE Auction at 4 p.m. FREE parking, hot food, door prizes, raffle and more. Reserve tables early—last year's show was a blow-out! *Multiple table discount. Call John at* (708) 837-1343 *or Jim at* (708) 439-6922 to reserve tables or obtain flyer. [2/96]

PRODUCT NEWS



USR&D CORP.

AERO*COMP Version 1.0-G

Use this software to analyze the performance of your gas- or glow-powered aircraft. It will predict takeoff rpm, motor power, thrust, rate of climb, air speed, glide ratio and more. It features a database of 53 airfoils and more than 200 powerplants, pull-down menus and detailed "Help" screens, and a horsepower calculator allows you to determine the peak power and rpm of your powerplant. AERO*COMP Version 1.0-G will run on all IBM PC and compatible computers.

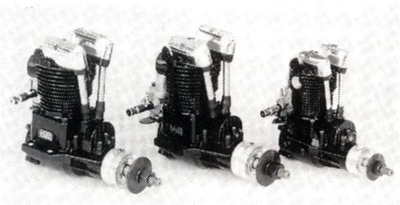
USR&D Corp., P.O. Box 753, Hackettstown, NJ 07840-0753; (908) 850-4131.

BOB FIORENZE

Jet Smoker Fuel

Specially blended by Morgan Inc., this fuel provides excellent idle, acceleration and top-end performance. It contains anti-foaming agents (to reduce the possibility of running lean at high rpm) and an after-run oil (which produces the smoke that creates a long-lasting contrail). It's available in 7-percent-nitro and 12-percent-nitro blends. Send $2 for an illustrated catalogue.

Bob Fiorenze, P.O. Box 953042, Lake Mary, FL 32795; (407) 330-1448.



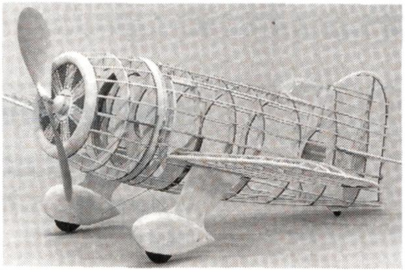
SAITO

Golden Knights

Previously available in .50, .65 and .80cid, these engines now come in .91, 1.20 and 1.50 sizes. All the engines in this series have glossy, black-finished cases and polished-gold valve covers, and each comes with an extended carburetor venturi for improved airflow.

Part nos.—SAIE091SGK (FA-91SGK), SAIE120SGK (FA-120SGK), SAIE150GK (FA-150GK); **prices**—$474.95, $579.95, $634.95.

Saito; distributed by Horizon Hobby Distributors Inc., 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.



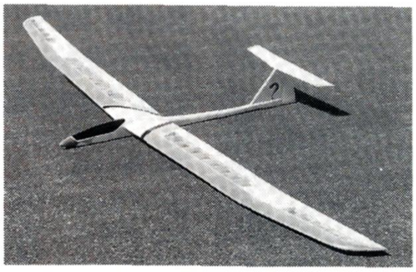
HERR ENGINEERING CORP.

Gee Bee R-2 Racer

This new, easy-to-build, rubber-powered kit has a 24-inch wingspan and more than 100 accurate, laser-cut balsa parts. The kit includes contest rubber, a hardware package, CAD plans, three-color water-slide decals, tissue covering, a molded plastic spinner, a clear canopy and an assembly manual.

Price—$36.95 (plus $4 S&H).

Herr Engineering Corp., 1431 Chaffee Dr., Ste. 3, Titusville, FL 32780; (407) 264-2488; fax (407) 264-4230.



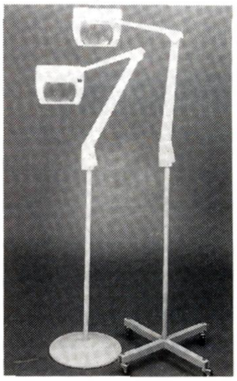
L&H DISTRIBUTORS

Mystery Ship

This all-wood, laser-cut sailplane comes with built-up wings, a full D-tube, double shear web spar, capstripped ribs, ailerons and flaps. The fuselage's tab-lock construction ensures strength and ease of alignment, and the ship has lite-ply sides, a balsa top and bottom and a full flying T-tail. Specifications: wingspan—118 inches; wing area—973 square inches; flying weight—62 ounces; fuselage length—53.25 inches; airfoil—SD7037.

Price—$169.95

L&H Distributors, 1520 B Corona Dr., Lake Havasu City, AZ 86403; (520) 855-6900.



DAZOR MFG. CORP.

Stretch-View™ Magnifier

This $6\frac{3}{4}$x$4\frac{1}{4}$-inch hands-free magnifier has a lens made of high-quality crown optical glass, and it comes in several levels of magnification. It's illuminated by a compact 18W fluorescent lamp. For more information and a catalogue, write to Dazor.

Part nos.—8MR 300/3050R (pedestal stand), 8MR 300/1050 (caster stand).

Dazor Mfg. Corp., 4483 Duncan Ave., St. Louis, MO 63110; (800) 345-9103.

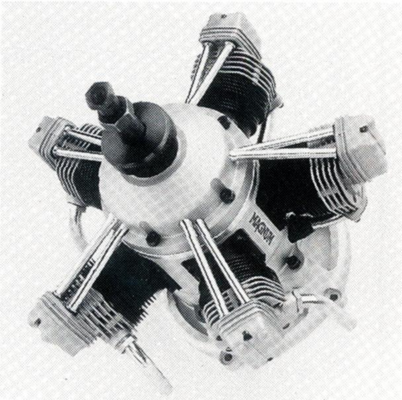
PRODUCT NEWS

PACIFIC AEROMODEL MFG. INC.

Sukhoi Su-26

The tubular fuselage on this light, almost-ready-to-fly model is made of one piece of thin plywood, and its wings are balsa-covered foam-cores. The model is covered with permanently bonded, fuel-resistant decorated polyester film. Specifications: wingspan—54.5 inches; wing area—520 square inches; length—42 inches; weight—5.2 pounds; engine required—.40 to .46 2-stroke or .48 to .60 4-stroke; radio required—4-channel.

Pacific Aeromodel Mfg. Inc., 760 Stimson Ave., City of Industry, CA 91745; (818) 961-4616; fax (818) 330-9351.



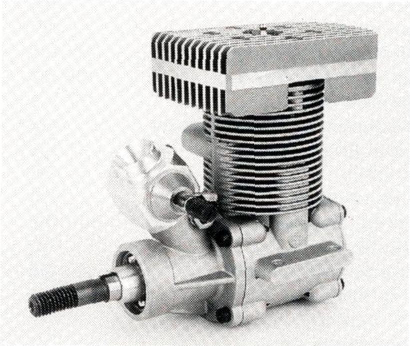
MAGNUM

XL-400-5R Radial 4-Stroke

The parts (including the mount) in this 5-cylinder, 4cid (65cc) engine have been CNC-machined out of a single block of aircraft-grade aluminum alloy. Initial tests with a 22x8 prop at sea level produced an idle of 1,800rpm and a top end of 6,500rpm.

Part no.—210400

Magnum; distributed by Global Hobby Distributors, 10725 Ellis Ave., Fountain Valley, CA 92728-8610; (714) 963-0133; fax (714) 962-6452.



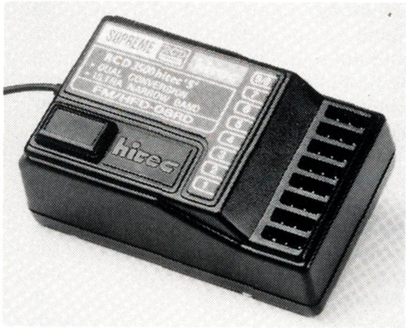
WEBRA

.61 Heli Engine

Built for performance, this dual ball-bearing engine has a ringed piston design and provides from 2,000 to 16,000rpm. Its 9.5mm Promix carburetor delivers accurate fuel metering through a unique slotted design.

Part no.—WEBE675; **price**—$279.95.

Webra; distributed by Horizon Hobby Distributors, 4105 Fieldstone Rd., Champaign, IL 61821; (217) 355-9511.



HITEC/RCD INC.

Supreme Series Receiver

This 8-channel, dual conversion FM receiver weighs only 1.34 ounces and has a tight adjacent-channel rejection, a high 3OIP rejection and a long range.

Part nos.—RCD3200 (Futaba J), RCD3400 (Airtronics), RCD3500 (Hitec), RCD3600 (JR), RCD3250 (Futaba J—50MHz), RCD3640 (JR—50MHz); **price**—$99.95.

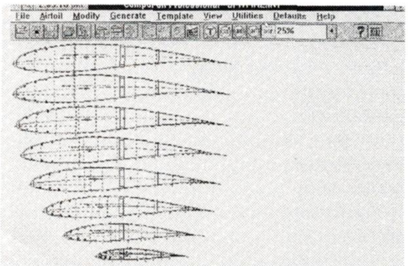
Hitec/RCD Inc., 10729 Wheatlands Ave., Ste. C, Santee, CA 92071; (619) 258-4940; fax (619) 449-1002.

TNC ELECTRONICS

Plus Tachometers

TNC Electronics now offers an updated, Plus version of their prop, fan and prop/fan tachometers that use temperature compensated, crystal-controlled oscillators. The Plus tachs never need calibration and are accurate to five parts per million. All optical and electronic characteristics, such as sensitivity and readout stability, are identical to those of the original tachometers.

TNC Electronics, 1 Whites Ln., Woodstock, NY 12498; (914) 679-8549; fax (914) 679-5542.



SOARSOFT SOFTWARE

CompuFoil Professional

Already available in DOS, this new version is for Windows. The program can quickly and easily produce foam-core templates or full sets of ribs in straight taper, elliptical and modified elliptical planforms. Full support for jig holes, spars, sheeting and leading edges is included.

SoarSoft Software, 3904 Traine Dr., Kettering, OH 45429; phone/fax (513) 299-7684; internet: compufoil@aol.com.

A D V E R T I S E R   I N D E X

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I certify that the statements made by me above are correct and complete.

Gary W. Dolzall
Associate Publisher

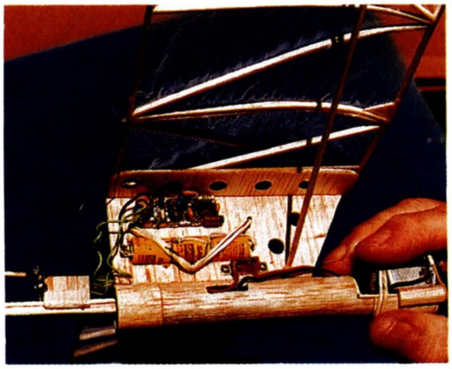
FINAL APPROACH

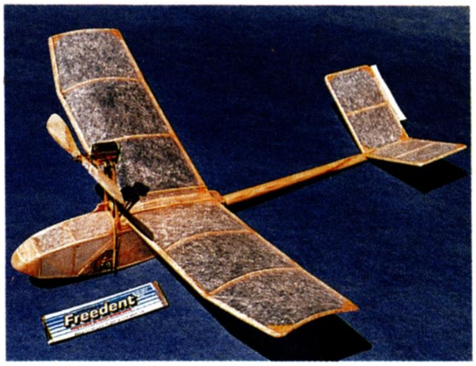
MICROLIGHT R/C ELECTRICS

HOW WOULD you like to fly a 2-ounce, electric R/C airplane, or a ½-ounce, 13-inch-span, peanut-scale electric with no batteries? These two ingenious originals are the work of a retired electronics engineer who also happens to be an old-time model builder. His name is Mario DiDiego and, evidently, he thrives on challenges. He is also a rare breed of modeler who designs, builds and flies single- and multi-rotor R/C autogyros.

Mario holds the Ultralight R/C. It has a radio that operates off a frequency of 49MHz. The signal is generated by pulsing a key chain, car-alarm transmitter that has a range of 300 feet.

The 2-ounce R/C model has a wingspan of 28 inches with a chord of 4 inches, and it's covered with clear plastic film one half mil in thickness (cut out of supermarket shopping bags). The all-balsa structure carries two sets of Ni-Cd batteries: one delivers 3.6 volts to the motor; the other delivers 3.6 volts to the receiver. The five-stage, super-regenerative radio operates on a frequency of 49MHz. It is pulsed by a tiny (1½x2-inch) key-chain, car-alarm transmitter, and its useful operating range is about 300 feet.





Above: here is a close-up of the radio system installation. There are 26 components in the radio, and it weighs 3½ grams.

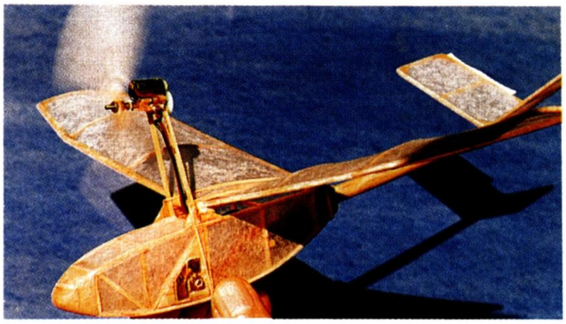
Above right: this version of an Ultralight is powered by a small capacitor that has a very large electrical capacity. The stick of Freedent gives a good indication of the size of the plane.

There are 26 components in this radio with five NPN transistors, only one of which is a high-frequency type. The radio weighs 3½ grams. The single servo operates the rudder only—a throwback to the early days of R/C. To save weight and make the pushrod stroke adjustable, Mario stripped it out of its casing and mounted it on a tee rail.

The motor is geared down with a 4:1 ratio turning a 4½-inch-diameter plastic prop. The prop keeps spinning when the motor stops. The flight duration is around 1 minute.

Mario also made a very small Ni-Cd battery charger. Its output is 1200mA at 7.2 volts. A transistor acts as a voltage regulator with a flashlight bulb that acts as a current limiter. Together with a diode in series, the transistor reduces the charging voltage to approximately 4.3 volts and 150mA.

This model is unique in that it has no batteries to power the motor. Instead, Mario has installed a very small capacitor that has a very large electrical capacity. It measures around ⅝ inch in diameter, is 1 inch long and weighs 4 grams. It's rated at 3.3 farads! (Not microfarads!) During a 20-second charge, sufficient electrical energy is stored to power the motor for a 60-second flight.



The capacitor, when charged for 20 seconds, will produce a motor running time of 60 seconds. That should be enough time to get the plane to the rafters of the flying arena and allow a nice, gliding descent.

The motor that weighs 3 grams came out of a beeper and is geared down to a 4:1 ratio with plastic gears. It runs on as few as 1½ volts. The 3½-inch-diameter, hand-carved balsa prop is mounted on a pylon to prolong its life. The wing is covered with tissue paper with one coat of dope, and the underside is braced diagonally with non-stretch Dacron™ threads between the ribs. The whole airplane weighs 14 grams, and it has a wing loading of 2.23 grams per square inch.

If you'd like to build an Ultralight model, or receive a catalogue of these small motors and extraordinary capacitors, send an SASE to Kenway Microflight, P.O. Box 889, Hackettstown, NJ 07840.

—Frank Gudaitis ■